NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

No. 44. Vol VII. OCTOBER. 1895.

NOTES AND COMMENTS.

The British Association and the President's Address.

IN England we are very civil to political reputation. Last year the brilliant phrases and epigrammatic eloquence of Lord Salisbury caused a tendency to overrate the scientific value of his address. The president of this year is not a famous politician, and his name is associated with no scientific work that has tickled the ears of the leader-writers; and so in the newspapers, from which most of us take our daily prejudices, there is a tendency to underrate the Association. We are inclined to think, however, that Sir Douglas Galton's quiet review of the history of the British Association is a document of considerable value. It is true, as the newspapers say, that there are many congresses now, and that the Association is but one among them. Still, it is the parent of most of them, and it has played a large part in directing the attention of a lethargic public to the progress and advantages of scientific inquiry. Moreover, as the president showed, the Association has had a direct influence upon the progress of inquiry by the reports it has issued from time to time. These have systematised work in hand and have had great influence in directing the course of its progress. Sir Douglas Galton has had so long an experience in the working of the Association that he could speak of its history and achievements with an intimate authority possessed by few.

Ether.

The president of the mathematical and physical section dealt with some of the ultimate problems of science. At present, our knowledge of matter and motion consists of little more than a series of empirical laws. "A statement of a law," said Professor Hicks, and his words cannot be pleasant reading for the good Duke of Argyle, "is either a confession of ignorance or a mnemonic convenience. It is the latter

if it is deducible by logical reasoning from other laws. It is the former when it is only discovered as a fact to be a law." The highest goal of science is to reduce ultimate laws to one or two, the necessity for which lies outside the sphere of our cognition. The ultimate laws are the dynamical relations of matter to number, space, and time. The ultimate data will be number, matter, space, and time themselves. If, as Professor Hicks apparently expects, it turn out that all phenomena are manifestations of motion of one single continuous medium, then the notion of force will be unnecessary, and the study of dynamics will be replaced by study of the equation of continuity. So, in the far future, all the ultimate problems are to be for mathematicians.

Even in the meantime the constitution of atoms and the constitution of the ether are problems chiefly for mathematicians. For, although we may take these to be seeable things, they are unseeable to us "because our senses are too cross-grained to transmit impressions of them to our mind." "The ordinary methods of investigation here fail us; we must proceed by a special method, and make a bridge of communication between the mechanism and our senses by means of hypotheses. By our imagination, experience, intuition, we form theories. We deduce the consequences of these theories on phenomena which come within the range of our senses, and reject or modify, or try again." The special theories with which Professor Hicks was dealing were the vortex-atom theory of matter and the vortex-sponge theory of the ether. The older theories, those which most of us were taught, held that atoms were rigid and that ether, although of extreme tenuity, was an elastic solid. The great difficulty of the rigid atom theory was that it gave no explanation of the apparent forces that hold atoms together. The elastic, solid ether broke down when confronted with reflection and refraction. Professor Hicks shadowed forth how the vortex-atom theory could be applied to the chemical combinations of atoms. Similarly he sketched a possible constitution of a spongy ether consisting of applied vortex-systems. These are matters entirely for mathematical treatment. But it seems that difficulties like the old theoretical action at a distance would vanish under the new theories. Light, electricity, and magnetic fields are in process of being reduced to mathematical properties of the spongy ether; and, most fascinating suggestion of all, Professor Hicks indicated that gravity itself may be turned from a law "observed as a fact" to a mathematical inference.

The Synthesis of Organic Compounds.

In his presidential address to the chemical section, Professor R. Meldola discussed the fascinating subject of structural chemistry, a subject which no doubt will receive its ultimate explanation on the

lines suggested in the mathematical section, but which at present is considerably more advanced than the structure of the atom and of ether. Incidentally Professor Meldola stated that he was preparing a catalogue of the so-called organic substances that have been synthesised. It seems that alcohol was the first organic substance formed by chemists in the laboratory. At the time, however, it was not recognised that alcohol was a substance really formed by the agency of living things, and, consequently, the synthesis of it by Henry Hennell, in 1826, attracted little attention. It was when Wöhler, in 1828, prepared urea from ammonium cyanate that the current conceptions of organic chemistry were shaken, as urea obviously was a product of the living animal. Even this synthesis, however, may not be regarded as complete, for at that time ammonium cyanate had not been prepared from inorganic elements. This, of course, has now been done, and not only urea but a large number of other substances have been built up in the laboratory from inorganic elements. "From the time of Wöhler and Hennell, the course of discovery in this field has gone steadily on. The announcement of a new synthesis has ceased to produce that excitement which it did in the early days when the so-called 'organic' compounds were regarded as products of a special vital force. The interest among the uninitiated now rises in proportion to the technical value of the compound. The present list of 180 odd synthetical products comprises, among the latest discoveries, gentisin, the colouring matter of the gentian root (*Gentiana lutea*), and caffein."

But Professor Meldola is not certain that it is an adequate idea of synthesis to restrict the word to the building up of compounds from lower substances. He doubts, for instance, and many physiologists will agree with him, whether in the vital laboratory of the plant the formation of compounds is often one of synthesis in the strict sense of the word. Like Bunge, the great German physiological chemist, and like many English physiologists, he insists on the part played by protoplasm in all these processes. He suggests that the first stage to be explained is the nature of assimilation, and hints that in many cases assimilation may be the formation of a compound between protoplasm or some of the proteids in protoplasm and the foreign substance. The subsequent formation of the organic substances in the cell might then be, not a true synthesis—a building up from low to high, but the formation of a lower compound from the complicated union of protoplasm with other bodies. And in this connection he recalls Sachs' opinion that starch itself is the first visible formation in the assimilating processes of the green cells. "The future development of vital chemistry, however, rests with the chemist and physiologist conjointly; the isolation, identification, and analysis of the products of vital activity, which has hitherto been the task of the chemist, is only the preliminary work of physiological chemistry leading up to chemical physiology."

Underground Geology.

The President of the Geological Section, Mr. W. Whitaker, devoted the greater part of his address to a discussion of the underground geology of East Anglia. The underlying geology of this district is, in the first place, obscured by Drift; but the well-sections, which Mr. Whitaker has always been so indefatigable in recording, have enabled the lines to be drawn with far greater precision than was formerly the case; especially have the older Tertiary beds been found to have a greater northward extension than is depicted on the older maps. Our knowledge of the deeper palæozoic rocks has likewise been greatly increased, partly from borings made for water, partly from borings with the direct object of investigating those rocks, often with the ulterior motive of searching for coal. Reasoning from the southern outcrops of the British Coal Measures, Mr. Whitaker cannot see why we should expect anything but a like occurrence of Coal Measures, in detached basins, in our vast underground tract of old rocks. He therefore urges fresh trial-borings. "The long gap between the distant outcrops of the Coal Measures near Bristol and Calais has been lessened very slightly by the working of coal under the Triassic and Jurassic beds near the former place, but much more by our brethren across the narrow sea," who have not only proved, but actually worked coal beneath their Jurassic and Cretaceous beds. The one trial that we have made, the Dover boring, has succeeded in proving the presence of coal under eastern Kent. But there is no reason why we should stop with this one boring, or even along this one line. In this case we cannot say that "one trial will suffice." It is our duty to seek, in East Anglia and elsewhere, for the other basins that so probably exist. Nor should we be discouraged by one or two failures. Among other reasons, the apparent absence of coal from a boring that strikes rocks older than the Coal Measures may be due to overthrust faults; such have been actually proved to occur in the adjacent Coal Measures of the Continent. "Our trial-work does not yet lead us to consider such disturbances. We have at first to assume a normal succession of formations, and not to carry on explorations in beds that can be proved to be older than the Coal Measures; but the time may come when it will be otherwise."

Subsequently, in the same section, Mr. F. W. Harmer made a plea for the systematic exploration of the subterranean geology of Great Britain and Ireland. He pointed out that at present our knowledge of the structure of the rocks below the surface is due either to isolated and occasional borings, such as that of the Ipswich Syndicate in search of coal, or to deep wells sunk by mercantile firms. He urged that the discovery of new mineral beds enriches, not only the lucky landowners, but the whole State. Apart from the increased employment and general prosperity of the district, he calculates that for "every £100 of yearly unearned increment the State is benefited in one way or another by £25, or one-fourth of the amount." His

practical suggestion is that, with the consent of Parliamentary and local authorities, a royalty should be charged on any minerals obtained below a certain depth, while landowners might defray a part of the cost of borings upon their estates.

Murray's Mud-line.

In the Zoological Section, Professor Herdman discussed chiefly problems of oceanography, problems with which his own great experience in dredging rendered him specially familiar. After paying a high compliment to Dr. John Murray, a compliment which must have echoed in the minds of every naturalist who heard it, he discussed at some length the existence of what Murray has called the "Mud-line" around coasts at a depth of about one hundred fathoms. "It is the 'point at which minute particles of organic and detrital matters in the form of mud begin to settle on the bottom of the ocean.' He (Murray) regards it as the great feeding ground, and a place where the fauna is most abundant, and from which there have hived off, so to speak, the successive swarms or migrations which have peopled other regions—the deep waters, the open sea, the shallow waters and the estuaries, fresh waters and land." In fact, to this region Murray assigned the importance that, it may be remembered, Professor Moseley assigned to the shore generally.

Professor Herdman thinks that the limits of the mud-region are much more variable and its fauna much scantier than Murray's view requires. "In the Irish Sea mud may be found at almost any depth, but is very varied in its nature and in its source. There may even be mud laid down between tide-marks in an estuary where a very considerable current runs. A deposit of mud may be due to the presence of an eddy or a sheltered corner in which the finer particles suspended in the water are able to sink, or it may be due to the wearing away of a limestone beach, or to quantities of alluvium brought down by a stream from the land, or to the presence of a submerged bed of boulder clay, or even, in some places, to the sewage and refuse from coast towns. Finally, there is the deep-water mud, a very stiff, blue-grey substance, which sets, when dried, into a firm clay, and this is, I take it, the mud of which Dr. Murray writes. But in none of these cases, and certainly not in the last-mentioned, is there, in my experience, or in that of several other naturalists I have consulted, any rich fauna associated with mud. In fact, I would regard mud as supporting a comparatively poor fauna as compared with other shallow water deposits."

Dr. Herdman supported his view by a large quantity of evidence, all of which went to show that the "Coralline" zone, and especially the "Laminarian" zone, have much richer faunas than those of the muddy regions.

Myology as an Aid in Classification.

In future numbers of Natural Science we hope to deal with a number of the interesting communications made to the Zoological Section—notably, for instance, with the question of oysters and typhoid. We are glad, however, to select for immediate notice a short paper read by Dr. Parsons upon the value of muscles in classification. Owing to the technical nature of the subject and the limits of time, it did not excite so much discussion as the subject requires. Muscles are structures rather neglected by most zoologists, and there is a general impression that they are too variable to be of much use from a systematic point of view. As we have repeatedly urged, however, we believe this view to be erroneous, and that zoologists will find in muscles a material as rich, from every point of view, as bones.

Dr. Parsons reviewed some of the reasons which have induced systematists to place little reliance on the study of muscles. He proceeded to give some account of the muscles in the Order of Rodents, a subject on which he has contributed numerous important memoirs to the *Proceedings* of the Zoological Society. He showed how closely the muscles correspond in animals nearly related, and how little the different modes of life of their possessors affect them. We hope that Dr. Parsons' paper will shortly be published in full in Natural Science.

Tunicata.

One of the first debates over which Professor Herdman found it his lot to preside in Section D was, appropriately enough, a discussion upon the classification of the group the study of which he has made his own speciality. In a group of animals in which budding and the formation of colonies has been carried to so high a degree as in the Tunicata, it is not surprising that the tangible characters, which these processes of growth supply, should have been largely employed in the earlier schemes of classification. Professor Herdman's own scheme, as set forth in his "Challenger" report, and recently revised, is, perhaps, the most complete of these apotheoses of budding, a fact which is none the less remarkable because the Professor has himself acknowledged that his classification of the group involves an unnatural separation of forms admittedly allied.

Mr. Garstang, in an interesting paper, insisted upon the importance of the *Pyrosoma*-stage discovered by him in the development of various fixed Ascidians. He thinks this instance of recapitulation remarkably complete, and holds that it furnishes in itself ample evidence for the contention that the fixed Ascidians have been derived from a *Pyrosoma*-like ancestor, and not *vice versâ*. The remaining pelagic types of Tunicata also agree with *Pyrosoma* in possessing a single row of undivided gill-slits (or protostigmata), so

that the outlines of the suggested system become clearly marked. The following subdivisions were proposed, and were based by Mr. Garstang upon the scheme of Mr. Lahille:—

Perennichordata .. .. Appendicularians.
Caducichordata.
I. Thaliacea. Protostigmata undivided; cloaca posterior. Pelagic.
i. Myosomata. Musculature in bands; lateral atria small; internal longitudinal bars absent.
e.g., Doliolum, Salpa, Anchinia.
ii. Pyrosomata. Musculature diffuse; lateral atria large; internal longitudinal bars present.
e.g., Pyrosoma.
II. Ascidiacea. Protostigmata subdivided into rows of secondary stigmata; cloaca dorsal. Fixed.
i. Stolidobranchia. Internal longitudinal bars present; bars solid and ribbon-shaped,
e.g., Botryllus, Cynthia, Goodsiria.
ii. Phlebobranchia. Internal longitudinal bars present; bars tubular.
e.g., Perophora, Ascidia, Diazona.
iii. Aplousobranchia. Internal longitudinal bars absent; horizontal membranes present.
e.g., Clavelina, Distaplia, Amaræcium.

In the discussion which followed the reading of this paper the president genially acknowledged his conversion as to the relationship and position of *Pyrosoma*, but was still doubtful whether the time had come for discarding the old and convenient subdivision of the Ascidiacea into "simplices" and "compositæ" in favour of the system now advocated.

The subject was continued in a paper on Budding in Ascidians by Professor Ritter, of California. It was again shown that several compound Ascidians are less closely related to one another than to certain simple Ascidians which are themselves widely different from one another in internal organisation. But the paper was chiefly interesting as a contribution to the controversy concerning the bearings which budding in Tunicata has on the germ-layer theory. Professor Ritter's observations have led him to the conclusion that "in embryonic development the ectoderm produces the matrix of the test, the peribranchial sacs, and the central nervous system and hypophyseal duct, while in the bud we see these four parts of the animal produced by the inner or so-called endodermic vesicle." In this phenomenon we have what Professor Ritter calls an excellent case of "developmental opportunism." The effect of influences bearing upon the bud in its development has overcome all the hereditary tendencies and scruples of its tissues; though it is rather the means than the end which has undergone modification. According to a theory of Seeliger's, which Professor Ritter revives, this derivation of primarily ectodermal organs from endodermal tissues may possibly be due to the fact that the ectoderm is already specialised as a test-producing organ at the time of bud-production.

Botany.

Mr. Thiselton-Dyer, the Director of the Royal Gardens at Kew, was the natural President of the new Botanical Section of the Association. His address ranged over many topics, and its notable feature was its crisp, pungent, stimulating quality. Discussion of half the questions he raised would fill many numbers of Natural Science, and, indeed, might fill them profitably. Using a just and enthusiastic appreciation of Henslow, the friend and teacher, and, in many respects, the inspirer of Darwin, as a text, he made a timely comparison between the old and new schools of Botany. The old school was essentially a school of Natural History. It contented itself with simple appliances: Robert Brown used only a simple microscope, and, acting upon his advice, Darwin had no compound microscope with him on the "Beagle." Its great feature was the observation of things alive in their natural surroundings. The modern school equips itself with the most elaborate appliances: it employs most complicated methods: it is much more a technique than an observation. But Mr. Thiselton-Dyer is possessed of too much insight and too much humour to be of those who

> "Compound the sins they are inclined to,
> By damning those they have no mind to,"

and he made his comparison, not to exalt one method at the expense of the other, but that the modern school might remember the merits of their predecessors. We have no doubt but that the young men "trained at Cambridge" will take his agreeable frankness in the spirit in which it was meant.

Civilisations.

Professor Flinders Petrie, addressing the Anthropological Section, strongly urged the necessity of a neglected practical side of Anthropology. The English people, by accident or by the genius of their race, are brought in contact with a large number of other civilisations. In dealings with these other civilisations we are apt to attempt the imposition of our own standards and customs upon peoples to which these are alien. "The foremost principle which should be always in view is that the civilisation of any race is not a system which can be changed at will. Every civilisation is the growing product of a very complex set of conditions, depending on race and character, on climate, on trade, and every minutia of the circumstances. To attempt to alter such a system, apart from its conditions, is impossible. For instance, whenever a total change is made in Government, it breaks down altogether, and a resort to the despotism of one man is the result."

He believes that "the average man cannot receive much more knowledge than his immediate ancestors," and that the attempt to force such knowledge upon him ruins him mentally and physically.

Speaking from his own experience of Egyptians, he declares that the attempt to teach them reading and writing, which for us seem the beginning of all education, turns them into useless idiots. They cannot make use of such accomplishments, which are utterly incongruous with the past conditions of their race, and this erroneous so-called education prevents the development in them of the "great essentials of a valuable character—moderation, justice, sympathy, politeness and consideration, quick observation, shrewdness, ability to plan and pre-arrange, a keen sense of the uses and properties of things." It is quite otherwise with the Copts, whose ancestors have been scribes for hundreds of generations.

This particular instance is one of the most general application. It is necessary that the rulers of foreign races should understand that the civilisation of these Western islands in the nineteenth century is but one among many civilisations, or statical conditions of society. From the Andaman islanders to the Parsees each community of men has its own standards and traditions crystallised into a code that is stamped upon their brains. He urges that those who are being trained to be rulers of foreign races should be made to study other civilisations, if only in anthropological museums and in translations of literatures. Formerly, when classical education was supreme, every educated young man had, in addition to his own habit of civilisation, a knowledge of the kind of ideas of Greeks and Romans, and from the Old Testament of polygamous and patriarchal peoples. Now, other subjects of study—perhaps more valuable in other ways, are usurping the place of the older studies, and young men are going out to become Satraps, who may be experts in the mathematics, in the sciences, or in modern languages, but who regard the customs and religions of other races from the narrow outlook of the civilisation of Bayswater, the religion of a rural parish, or of a Presbyterian household.

We hope that Professor Flinders Petrie's weighty advice, which we have roughly paraphrased, will receive due attention.

Weismann and Spencer.

In the *Contemporary Review* for September Professor Weismann, after a considerable lapse of time, returns again to the controversy in which Mr. Herbert Spencer engaged him. We have no space to enter into the laborious details of the controversy, and, to be frank, the disputants seem to us to have abandoned empirical arguments for the arid regions of speculative metaphysic. But those who have bravely followed the controversy, not only in the essays of the main disputants, but in the innumerable writings of others, must be familiar with attempts to ridicule Weismann because he has set forward his theoretical construction of the germ-plasm as a real thing. He himself, with a reiterated modesty, has offered it merely as a working

hypothesis. "If anyone is inclined to reject my explanation because it leads into the obscureness of the germ-plasm, of the structure and vital processes of which we can learn nothing directly, let him remember that the origin of the variations cannot be found anywhere else, and that we must, therefore, form some conception of the germ-plasm if we wish to penetrate deeper into the riddle of phylogenesis at all. I simply submit my conception of the structure of the germ-plasm as a working hypothesis. Let it be tested by facts; let it be improved according to the results thus attained; let it be overthrown should it in the end prove unsatisfactory; but do not let us say in advance that such a thing cannot be!"

Many writers have confused the actual existence of a germ-plasm with Weismann's hypothetical conception of its structure. No one having the smallest acquaintance with the results of modern embryology doubts that there is a material contributed by each parent in parts of equal valency. In the same fashion as the properties of an amœba are resident in its protoplasm, the inherited qualities of an organism are resident in the portion of germ-plasm from which it sprung. Dr. Oskar Hertwig, who has been the most weighty critic of Weismann's hypotheses, agrees with Weismann, and, indeed, with everyone else worth considering, that the germ-plasm must be a material of extraordinary complexity. Weismann has endeavoured to interpret the observed phenomena of heredity into terms of a hypothetical structure of the germ-plasm. As he says himself, his interpretation may have to be enormously modified or abandoned as knowledge increases. But to object to it, as it seemed to us and to Weismann himself that Mr. Herbert Spencer objected to it, that it cannot solve a number of problems of heredity that as yet are insoluble upon any hypothesis, is special pleading for a verdict, and not helping to advance thought.

Life-History of the Foraminifera.

In Natural Science for November, 1894, we called attention to the abstract of a paper by Mr. J. J. Lister on the above subject. The full paper is now before us (*Philosophical Transactions*, vol. clxxxvi.) and is illustrated by four plates dealing with *Polystomella crispa*, *Calcarina hispida*, *Rotalina beccarii*, *Orbitolites complanata*, and *Cycloclypeus carpenteri*. The conclusions arrived at by Mr. Lister are as follows: (1) The species of Foraminifera are in a great number of cases dimorphic. (2) The two forms differ from one another in the following features, (*a*) the size of the central chamber, (*b*) the shape and mode of growth of the chambers succeeding the megalosphere and microsphere, (*c*) the character of the nuclei. (3) The two forms differ in the frequency of their occurrence, the megalospheric forms being much more abundant that the microspheric. (4) The megalospheric form arises as a young individual already invested by a shell, which may

be found lying in or about the peripheral chambers of the parent. (5) Under certain circumstances active zoospores are produced by Foraminifera. It therefore appears (says Mr. Lister) that we may safely conclude that the microspheric and megalospheric forms are distinct from their origin. What, then, is their relationship? When two forms of a species are met with in animals or plants they generally either belong to different sexes or they are members of a cycle of recurring generations. The hypothesis that the two forms of the Foraminifera represent the two sexes appears to be disproved by the fact that in *Orbitolites complanata*, Lam., both megalospheric and microspheric forms are found with the young of the megalospheric form (primitive discs) in their brood chambers. Other genera furnish analogous though less complete evidence. Hence it is impossible to regard either form as male. We turn, then, to the other hypothesis, namely, that the two forms are members of a recurring cycle of generations.

Mr. Lister goes on to show that in the reproduction of the microspheric form the whole of the protoplasm of the parent is divided into the young, and that these all belong to one form, the megalospheric. The fact that the whole of the protoplasm of the parent is used in the production of the young, and that these are all of one form, supports the view that the two forms of the Foraminifera belong to different generations. A fuller account of the process of reproduction is promised by Mr. Lister in a further paper, which we await with great interest.

The Structure of *Heliopora*.

Mr. G. C. Bourne's communication to the Royal Society upon *Heliopora* has now been published (July, 1895), and worthily maintains the Oxford traditions of the study of Cœlenterates inaugurated by Moseley. Professor Moseley himself made a notable contribution to our knowledge of *Heliopora*; but recent advances in knowledge of other alcyonarians made a re-examination advisable. Indeed, it was Moseley who, before his death, urged Mr. Bourne to undertake the investigation. The work was done in the Linacre Laboratory at Oxford upon Moseley's original material, with the addition of collections made by Mr. Bourne at Diego Garcia, Professor Hickson in Celebes, and Professor Haddon in the Torres Straits.

The chief point of general interest relates to the origin of the skeleton. By careful examination of young growing points Mr. Bourne was able to make out that, as G. von Koch suggested, the skeleton is truly ectodermal. The mesoglœa, or gelatinous middle layer, is formed by ectoderm cells, which either gradually become gelatinous at their internal edges, or losing continuity with the external layer migrate inwards, and first becoming surrounded by a layer of discharged gelatinous material, 'melt' away into mesoglœa.

Into the mesoglœa hollow outgrowths of the endoderm grow, and form a definite system of cavities. Externally to this, the layer of mesoglœa is formed by intruding cells from the ectoderm. Outside this again another definite layer of cells of ectodermic origin forms a well-marked layer of what Mr. Bourne calls *calicoblasts*, and it is this layer that gives rise to the skeleton. An examination of *Xenia* and *Heteroxenia* led Mr. Bourne to think that probably in a large number of alcyonarians the skeleton is ectodermal.

The matter on which we have touched is only a small part of Mr. Bourne's memoir. He discusses at length the nature of *Heliopora*, of the "animal" and the coral; but these are subjects too technical to be summarised here.

The Temperature of the River Nile.

We have received from Dr. H. B. Guppy a reprint from the *Proceedings of the Royal Physical Society of Edinburgh*, containing Part II. of his work on River Temperatures. This second instalment deals chiefly with the temperature of the waters of the Nile and its relation to the temperature of the air at different points and in different seasons, and is obviously the result of considerable labour and research. Observations of the temperature of the Nile are remarkably scarce, the pencil manuscripts of Mr. Robert Hay, which Dr. Guppy has unearthed in the British Museum, containing one of the most valuable series extant. The leading conclusions of the paper are accordingly based on comparisons with air temperature rather than on the actual water temperatures, a method which has recently been found very successful. We cannot do better than give the propositions stated by Dr. Guppy and ably supported by the discussion of the observations. During its course below the second cataract the Nile is in summer markedly cooler than the air; but the relative coolness diminishes as the river flows north, and the diminution is almost entirely due to the fall in the air temperature. In winter the Nile is still colder than the air between the first and second cataracts, but the difference of temperature is much less: between Assouan and Minieh the water is nearly two degrees (Fahr.) warmer than the air, and the excess is greater at Cairo. The approximation and crossing of the air and river temperatures is again mainly due to the fall of air temperature. It is remarkable that during the four seasons there is no great contrast in temperature between the water of the Nile and the surface waters of the Mediterranean.

Dr. Guppy further compares the thermal *régime* of the Nile with those of other great rivers. While pointing out that further acquaintance with the Brahmaputra and the Yangtse will probably disclose points of similarity, Dr. Guppy shows that the Nile is in strong contrast to the Congo and the Amazon, which flow east and west, and to the Mississippi, flowing south. The comparison with the last-

named is specially interesting. It is shown that, judging from monthly means, the range of temperature of the Nile water is less than that of the air, while in the Mississippi it is considerably greater: that the Nile is true to the climatic conditions of its latitude only in winter, and the Mississippi only in summer, or, to put it otherwise, that the influence of the higher courses is displayed in contrary seasons: that nowhere below the second cataract does the Nile attain so high a summer temperature as the Mississippi: and that in contrast to the Nile the temperature of the Mississippi waters is often widely different from the surface water in the Gulf of Mexico.

The paper concludes with the statement of a number of other points, and suggestions for further observations. We are glad to notice that Dr. Guppy promises to treat other great rivers of the world in the same detailed manner.

Toads in Holes.

No doubt it is the silly season, when editors are so put to it for copy that they have little time to revise what matter comes to hand; but our esteemed contemporary, the *Daily Chronicle*, surely had no need to fall back upon the exceedingly ancient error concerning the vitality of toads. Under the title "A Remarkable Release," they recount how some workmen in Bedfordshire, cutting up the trunk of a large oak uprooted during a recent storm, came across a toad "embedded in the heart of the trunk, about eighteen feet from the root." "The imprisoned creature, which must have subsisted for some years upon the sap, was about half the size of a fully-developed toad, and readily swallowed the worms, earwigs, and beetles which were given to it." It should be needless to recall the old experiments of Dean Buckland and others. By adopting the expedient of burying toads so sealed up that they could obtain moisture and air but no food, they found that toads were unable to live more than a few months without food. As a matter of fact, toads habitually conceal themselves in crevices and holes. In cases where they are found in tree trunks, stones, and so forth, either the hole by which they entered has been entirely overlooked, or they got in when they were very small and grew healthily upon earwigs and other insects that had sought similar concealment. We have no doubt but that if the workmen had examined the inside of this particular toad they would have found the remains of a more nutritious diet than the sap to be obtained in a hollow trunk.

Adders Again.

The holiday season has not yet brought into our hands a set of adders carefully preserved by the observers after they had swallowed their young. But there has come into our hands a pamphlet on the subject by Mr. H. Tootal Broadhurst. This consists of reprints of a

number of letters from various sporting papers relating how the writers saw young adders issuing from the mouths of old adders, or, in rarer cases, how they had seen or heard of their going in. Unfortunately, the pamphlet establishes no more than that there is a strong belief among gamekeepers, countrymen, and sportsmen. The pamphlet ends with a letter from Brusher Mills, of Clayton Hill, Lyndhurst, who declares that he has seen hundreds go in and out of the old adder's mouth, and offering to "show this to any gentleman who likes to come and see him in the last week of July or first week of August." We ourselves know Brusher Mills and know well that he has seen as many adders as anyone, and has caught more than anyone else. But, unfortunately, he was unable to win the reward of £5 offered by the *Field*, or of £1 offered by Mr. Tegetmeier.

A Botanical Station in Central Africa.

The Foreign Office Report C. 7829–2 contains some interesting information on the botanical and agricultural resources and prospects of the Shiré-highlands. The writer, Mr. Alexander Whyte, who is head of the Scientific Department, gives an account of his successful effort to establish a botanical garden at Zomba. The results seem to show that Zomba is eminently suited for the experimental cultivation of food-plants and other plants of economic value. English potatoes grown from seed turned out remarkably well. By constant selection, several large, well-formed, mealy varieties were obtained, equal in flavour to any English potatoes. Happily, too, they show no sign of disease. Barley and oats from English seeds were successful, while wheat grown from seed obtained from the missionaries at Tanganyika yielded at the rate of nine bushels to the acre, without manure. A series of conifers, cypress, thuja, and the Milanji *Widdringtonia* grew to an average height of five feet in two-and-a-half years, while some eucalypti shot up forty-five feet in the same period. A large terrace flower-garden made a brilliant display; balsams, phlox, zinnia, mignonette, and others seeded so freely that they became garden weeds. Geraniums grew to the height of hedges, and sunflowers and dahlias shot up into tall, shrub-like plants. Petunias, pinks, carnations, and, in fact, most of the plants experimented with were successful.

Mr. Whyte strongly advises extensive cultivation of indiarubber and gutta-percha yielding plants. The cheapness of land and labour would make the former at any rate a most remunerative venture. Fibre-plant cultivation would also admirably suit the natives. Unfortunately, the formidable tsetse fly will seriously interfere with the introduction and rearing of domestic stock, while a gad fly (*Tabanus latipes*) the size and shape of a large blue-bottle fly, is also most harassing to horses and cattle. Though said to be a great scourge in East Africa, the latter is seldom met with in Nyasaland.

As regards the tsetse fly, smearing the animals with a mixture of kerosene oil and cow-dung is suggested as a most effectual preventive. The West Indian jigger, a burrowing flea, has also just reached the districts round Lake Nyasa and the Upper Shiré, having slowly migrated eastwards from the West Coast, where it was introduced with ballast from Bahia in 1873.

The Ascent of Sap.

Why does sap overcome the attraction of the earth and rise to the summit of high trees? One explanation is that the root-hairs, by the vital action of their protoplasm, as well as by simple osmosis, absorb water from the soil and force it upwards through the stem. It has been shown that when the upper part of a vigorously growing plant is cut off and replaced by a tube containing mercury, the sap continues to ascend with force enough to raise the column of mercury. But even in the absence of "root-pressure" ascending currents are maintained: a shoot out from a stem will continue to absorb water and force it upwards. In a recent communication to the Royal Society (published July, 1895), Mr. Henry H. Dixon and Dr. Joly support the view that the 'suction-force' of the leaf is the "all-sufficient cause of the elevation of the sap, not, however, by establishing differences of gas-pressure, but by exerting a simple tensile stress on the liquid in the conduits." Meniscuses are formed in the exceedingly minute membranous meshwork of the evaporating cell-walls, and these are capable of supporting a tension equivalent to many atmospheres pressure, while the columns of liquid in the conduits of the plant supply the loss by evaporation. They support their simple mechanical view by ingenious experiment and inference; but they admit that the results may be complicated by osmotic processes in the leaf. We should add that they certainly are complicated by the vital action of the protoplasm. We know now that the protoplasm in all the cells of a plant forms a continuous net-work only incompletely divided by the cell-walls; and we should hesitate to accept any theory which did not allow for the direct 'vital' action of this net-work of protoplasm.

A Polemic from Victoria Park.

We have received from Messrs. Swan Sonnenschein & Co. a copy of a pamphlet entitled "Microbes and Disease Germs, the Truth about the Anti-Toxin Treatment of Diphtheria," by Edward Berdoe. The question of anti-toxins is of surpassing interest both from the general scientific point of view and from the clinical point of view. As a scientific review we are prepared to give the most careful attention to any serious scientific treatise, and we are ready to make large allowance for rhetorical violence in the treatment of a burning topic. But there must be some evidence that ability to take a serious

view of a serious topic underlies the rhetoric. Dr. Berdoe incorporates in his argument a leader from the *Star*, in the *Star's* happiest "Knock 'em in the Old Kent Road" vein. He talks about the anti-toxin, which he pretends to be discussing seriously, as "filth," and, with regard to the question of hydrophobia, he says he "would as soon believe the savages as he would M. Pasteur." For our part, we would as soon deal with the *Star* at first hand as a scientific treatise as we would with Dr. Berdoe. And we make our apologies to the *Star* for the comparison.

Count Solms-Laubach, Professor of Botany at Strasburg, has contributed to our Linnean Society, of which he is a foreign member, a Monograph of the Acetabularieæ (*Trans. Linn. Soc.*, vol. v., part i.). Of the four genera included in this sub-family of siphonaceous green algæ the largest, *Acetabularia*, contains fifteen species, seven of which are now described for the first time. Of these, five come from the seas of tropical Asia, especially the far east, five from the neighbourhood of the Gulf of Mexico, three from the Australian Coasts, and one from Mauritius. *Halicoryne* has two species, inhabiting the Loo-Choo and Philippine Islands and New Caledonia respectively. *Chalmasia* is a new genus with one species from the West Indies, while *Acicularia* contains one recent species from the West Indies and tropical South America and three fossil ones from the Miocene of the Crimea and Austria, and the Eocene of the Paris basin.

In our notice of the *Index to Periodicals* in our last issue (p. 214) we omitted to mention a suggestion which appeared in the *Review of Reviews* for August. Several letters have been received by Mr. Stead from readers, asking that certain magazines and periodicals of occasional service, not preserved in public libraries, should be stored at Norfolk House for the use of those requiring them. The idea further is that such should be available for loan and return. This is no doubt a good suggestion, but we fear even Mr. Stead would find it an overwhelming charge. It seems more to the point to suggest that Mr. Stead should present to some big library (say Guildhall, for instance) at certain intervals those periodicals received by him but missing in that library, rather than that he should start another library for their special housing.

I.

The Sixth International Geographical Congress.

THE Royal Geographical Society, as the hosts of the International Geographical Congress, may be congratulated on having scored a great success. The numerous Government delegates and representatives of foreign societies from all the ends of the earth have come and gone, and they have all expressed pleasure and satisfaction, alike with the serious work accomplished and with the entertainment provided for them. The responsibility of so large a gathering seems a heavy burden to lay on a Society like the Geographical, especially as it has not received any visible support from either the State or the Municipality, and has even had to pay a large sum for accommodation in the Imperial Institute. But the credit of success becomes thereby all the greater, as this is the first occasion on which the hosts of the Congress have been so thrown on their own resources.

Perhaps the secret of success in these meetings is that, like the British Empire, they have no definite constitution. Each city visited by the Congress is at liberty to make what arrangement it pleases, and so to make the best of itself; and the burning questions of geography can be discussed and settled in the manner best suited to the time and place of meeting. Compared with former Congresses, we should say that the sixth was remarkable for the just balance of its different parts, and for their mutual independence: when the Congress met in solemn conference it worked hard at the question in hand, undisturbed by a feeling that the Exhibitions were, after all, the most important feature; and when the deliberations were over there was still energy left to enjoy the round of gaiety.

Popular, as well as scientific, interest centred in the general meetings, which were convened each morning for the discussion of some important branch of geographical science, and usually continued, after adjournment, in the afternoon. The Sections, of which there were never more than two, and sometimes only one, did not usually meet till the afternoon, and devoted their attention to more technical matters. Antarctic Exploration was the feature of the first day. The subject was introduced by Geheimrath Professor Dr. Neumayer, the veteran chief of the Deutsche Seewarte. Various

shades of scientific opinion were represented in the discussion by such authorities as Sir Joseph Hooker—now the only survivor of Ross's Expedition in the "Erebus" and "Terror" in 1843—Dr. John Murray, Mr. de Lapparent, and General Greely. It was unfortunate that Mr. C. E. Borchgrevink did not reach this country in time to read his paper on the same day; but he was enthusiastically received at a later meeting, and it was felt that his description of the neighbourhood of Cape Adare removed one of the most serious difficulties which has hitherto stood in the way of Antarctic exploration—the want of a place suitable for wintering. We hope that the strong expression of opinion on the part of the Congress as to the results to be expected from an Antarctic expedition will help to bring this country to the sticking point; for if we do not undertake the work soon, somebody else assuredly will.

There was a general disposition to reserve judgment as to schemes for Arctic exploration until something is known about the expeditions at present in those regions. Mr. S. A. Andrée's scheme for sailing from Spitzbergen across the Pole in a balloon was rather severely criticised; but so far as appeared there was no fatal objection to the methods proposed. It takes a good deal of faith to believe that the wind will carry a balloon to the Pole and bring it back again to civilised latitudes; but if Mr. Andrée is willing to risk it, no one can prove it to be impossible, and a stroke of luck might realise the dreams of ages in a few days.

The other great field-day was over the colonisation of tropical Africa. Mr. Stanley to the contrary notwithstanding, it seemed to be clearly brought out that in tropical Africa, more than anywhere else, we must have a sound basis of scientific geographical knowledge of the country to go on before we can really know how to make the most of it. The acquisition of that knowledge will be costly enough, but not so ruinous in lives and capital as the methods we have been accustomed to adopt in the past. After the general discussion, to which Sir John Kirk, Count Pfeil, Mr. Stanley, Mr. Ravenstein, Mr. Silva White, Mr. Lionel Dècle, Slatin Pasha, and other authorities contributed, General Chapman read a paper on the Mapping of Africa. A resolution was afterwards drawn up on this subject by a committee, which recommended, among other things, the accurate determination of a number of fixed points from which travellers could take their "departures," and advised travellers to sketch areas rather than mere routes. We may be permitted to express the hope that similar excellent advice in other branches of science may be formulated for the benefit of explorers, who cannot be experts in every department, any more than people who stay at home. It seems a pity, for example, to burden a traveller, whose main object is to cover ground as quickly as possible, with a complete set of meteorological instruments and the maddening worry of observing with them. Rain-gauges and thermometers are excellent

in their place, which is necessarily fixed, but on a journey a full record of wind direction and force, and of cloud types and movements, with "weather notes," would be infinitely more valuable, and not half the trouble to keep. And yet few travellers know how to make the observations.

In the matter of geographical education, which only came before a Section, the discussion was more one-sided, this country being so far behind most of the others represented at the Congress. It was evident, however, that we have begun to move in the right direction, and the speed may increase geometrically; for it is only by geographical education we can learn that what is for the most part at present taught as such, is *not* geography, and, until we learn that, geographical education will probably remain more or less defective.

Another general meeting considered ancient maps, and for the benefit of future congresses an excellent resolution was passed pointing out to all cartographers and map-publishers that the value of their productions was greatly increased when they bore the date of their publication. Historical maps were rather a specialty of the Congress, by reason of the quite exceptional merit of Mr. Ravenstein's exhibition illustrating the rise and progress of cartography. This collection contained specimens of no less than thirty of the fifty-three known editions of Ptolemy, beginning with the "Geographia in terza rima," published at Florence in 1478, besides such treasures as the Queen's Leonardo da Vinci maps, the Mollineux globe from the Middle Temple Library, the "Henry II." map belonging to the Earl of Crawford, and endless others.

In the sectional meetings one had, of course, more opportunity of seeing "how it was done," and of being impressed with the variety of special subjects which legitimately fall within the range of geography. Surveying, like everything else, has become indebted to photography. Dr. Schlichter's application of it to the measurement of lunar distances is already well-known, and a modification of his method, which Captain Hills described, excited some interest. In drawing maps the uses of photography promise to be endless, and several very ingenious instruments have already done practical work, notably a combined theodolite and camera described by Mr. Schrader, and a "panoram" for producing photographs of the whole horizon, invented by Colonel Stewart and exhibited to the Congress by Mr. Coles. If we bear in mind, as Mr. de Dechy pointed out, that photography must always be *auxiliary* to triangulation, there seems no reason to suppose that a map constructed from a few fixed points and a number of photographs should contain serious errors. Indeed, Mr. Coles has already proved that it need not, by his map of parts of the Caucasus, founded almost wholly on such data.

Geodesy is one of those subjects in which even a moderate amount of progress represents an enormous quantity of work. The papers by General Walker and Mr. A. de Smidt, late Surveyors

General of India and at the Cape, gave results which could only be achieved after immense labour on the part of their respective departments. They made one regret that so many obstacles may stand in the way of seeing an unbroken line of triangulation stretch from the Cape of Good Hope northwards to the Nile Valley, and thence through Greece to the North Cape; and another from Ceylon, across India and Russia, to the same point.

Many papers of interest were presented to the sections at other meetings; but, for want of space, we must omit even the titles of most of them. One meeting considered the Morphology of the Earth, in which Professor Penck opened the proceedings with a paper on the Morphology and Terminology of Land Forms. We may hope soon to see a translation of his great book, which will give this subject its proper position in this country. In the Section on Oceanography a feeling of satisfaction, mingled with regret that the work of the "Challenger" Expedition Commission had come to an end, was distinctly observed; but there was evidence of plenty of work going on in building on that great foundation. The Prince of Monaco sent an account of recent work on board the "Princess Alice," and Professor Pettersson, of Stockholm, propounded a scheme for further work in the North Sea—with the British share in this readers of Natural Science are already familiar—a scheme which afterwards received the unanimous approval of the Congress. Some progress was made towards a reformed system of geographical spelling, of which even the outsider, who finds that Venezia, Venise, Venice, and Venedig are all the same place, may well appreciate the need, even when he is not concerned with place-names in Central Africa.

There seems little doubt that the International Geographical Congress, as a body, has found its work, and we may confidently expect that when it meets in Berlin in 1899 it will have great achievements to show, especially as it has decided that its present officers are to retain their posts during the interval.

H. N. Dickson.

II.

The Rôle of Sex.

Part II.

The Utility of Conjugation.

As already mentioned, there are two methods of reproduction, asexual and sexual. In the former case, a portion of an individual, generally a reproductive cell, grows and develops into an adult. Thus, in certain times of the year the aphides produce fresh brood without sexual assistance, and tubers and cuttings can be used in the propagation of potatoes and roses. In the case of sexual reproduction, matter, generally in the form of reproductive cells, is mingled by two individuals, and from the resultant mass development proceeds. Now, it appears that there are some material advantages to be gained by the second method, for we find that long-continued asexual reproduction leads to deterioration and final extinction. Thus, trees and plants produced for many years by tubers or cuttings, show marked deterioration, or become subject to disease, an indication of some hereditary weakness. The ciliated infusoria observed by Maupas pass through periods where sexual conjugation does not occur, but finally, if life is to continue, they must conjugate with individuals of other stocks. Conjugation, and especially conjugation between different stocks of the same species, is, therefore, in some way advantageous, even necessary, and we have now to ask in what way it is advantageous.

Many naturalists affirm that the process of conjugation is a rejuvenescence, and are content with this. But this is no explanation, and cannot be viewed even as an attempt at one. It is a fact that plants or animals deteriorated by long-continued asexual reproduction may make a new and vigorous start if permitted to conjugate with other individuals; but to say that this is rejuvenescence merely expresses, by a metaphor of very superficial application, the fact which we are called to explain.

According to Weismann, sexual reproduction is of utility, inasmuch as he supposes that it "gives Natural Selection a choice of innumerable combinations of the most diversified variations to act upon."[1] "I am convinced," he says, "that the conjugation of

[1] *The Germ Plasma, a Theory of Heredity.* Translation by W. N. Parker; London, 1893; pp. 413, 431, and 463.

unicellular, and the sexual reproduction of multicellular organisms, are means of producing variations. The process furnishes an inexhaustible supply of fresh combinations of individual variations which are indispensable to the process of selection." Here is a definite scientific hypothesis which can be examined in the light of such facts as we possess.

Weismann, we must observe, does not affirm that variation is primarily due to conjugation, but agrees with Darwin and most others in thinking that the power to vary lies in all protoplasm independent of conjugation. In support of this, we know that no two cells of the body are quite similar to each other, and many are very unlike, yet these have arisen from the original fertilised ovum by asexual division, without conjugation. By repeated division the fertilised ovum gives rise to cells which at once begin to vary, and finally change into what we call the cells of epithelium, muscle, cartilage, etc. In plant life we constantly come across variations in which sexual union has played no part; such, for instance, as eccentric leaves and branches which may suddenly arise during the life of a growing tree.

The use of sexual conjugation is, according to Weismann, to give to natural selection a *greater* choice, to present to it an *increased* number of variations. Now, at the outset, this explanation of the utility of sexual conjugation appears to me to be unsatisfactory, because in natural selection alone we have the means of bringing about any degree of variability we require. If some of the individuals of a species are not variable enough, natural selection will preserve the more variable ones, thus increasing the variability of the species; for variability, like everything else, can be transmitted by heredity. The extraordinary power of selection in modifying variability may be appreciated when we study in contrast wild and domesticated or cultivated animals and plants. In the wild condition most types remain practically unchanged for long periods of time, they have become adapted to their conditions of life, and these as a rule remain pretty uniform. Natural selection will operate largely in destroying any marked variety, and those strains will be perpetuated which evince little tendency to produce variation. When, however, we cultivate or domesticate these types, and when we encourage variations by selecting them in preference to forms of the original type, we preserve variable strains, and the breed under domestication may become very variable. Weismann's theory of the use of conjugation assigns to it a function possessed in marked degree by natural selection, and we are tempted to believe that it will have a function peculiar to itself.

Let us examine a little more closely the facts of sexual and asexual reproduction, contrasting these with each other. It is generally acknowledged, and it was strongly emphasised by Darwin, that among plants a variation can be propagated with certainty by the asexual method alone. If we try to perpetuate it by seeds it

tends to revert to the original type, and on this account it is the custom to perpetuate suitable varieties by means of grafts and cuttings. In the case of the ciliated infusoria passing through several generations of asexual reproduction, we find progressive changes terminating in debility and death. In reproduction without conjugation an individual is cut off completely from the rest of the species, and gives rise to an isolated line of descendants. If the individual is a variety its progeny will almost to a certainty be varieties too, subject always to fresh and changing variation. In its line of descendants every fresh individual starts again on a fresh line, and so it goes on like a tree, the branches of which never touch. Sooner or later every living individual will be found to have deviated in all possible directions from the ancestral form.

Now, in the case of reproduction with conjugation, the facts differ widely from the above. The progeny of two parents tends to what we may term, after Galton, the mid-parent [1]—nay, it tends even more to approach the mean average type of the species than the mid-parent itself. In plants, as Darwin has shown, much the same thing occurs, the progeny being either intermediate between their parents in all points, resembling one parent most in one point, and another in another point, or the influence of one parent may predominate over the influence of the other. To take two concrete cases, the branch of a tree which differs from the rest by having variegated leaves, may be propagated again and again by cuttings, but a six-fingered man, although he may pass on this variety to some of his more immediate progeny, will not permanently impress the race. In the latter case, each crossing will enable the influence of more typical members of the species to assert itself, and so by degrees the variation will, as it were, be overpowered. Conjugation previous to reproduction tends therefore to bring the offspring of varieties more towards the mid-type of the species; it works in distinct opposition to variation, and the latter can never establish itself unless it is useful and external circumstances are peculiarly favourable, preserving only those of the offspring which continue to show in some degree the parental variation.

Now, it appears to me a matter for some surprise that, with the facts so clearly stated by Darwin, Galton, and others, and accepted by Weismann himself, biologists have not accepted these as establishing very fully the *rôle* or function of conjugation. It has this *rôle:* it brings the offspring of the act of conjugation nearer the mid-type than even the mid-parent itself, while the cutting from the variegated branch deviates as markedly from the mid-type as the branch itself. I venture, therefore, to bring forward this explanation of the *rôle* of sex, not as a theory, but as a fact, resting on a solid basis of experimental evidence hitherto ignored in this relationship.

I imagine that Weismann, and the many biologists who follow

[1] *Natural Inheritance.* By Francis Galton, 1889.

him, have been led aside by the very natural claim upon the attention which the results of variation must present. We have in nature thousands of species and varieties living lives as diverse as are their bodily constructions. These are the objects of interest to the naturalist, and the chief aim of his study is to discover how they arose and what was the story of their development. But we have to remember that, although to us variations are of great interest, they but occasionally establish and transmit themselves—one to a million as against the transmission of more typical individuals.

For a thousand years the bird which has white plumage or the sheep which has short legs will die of hunger or fall a prey to foes before even sexual maturity is reached. Only when it finds itself in a land of snow will the white bird have a chance, and the sheep with short legs is only safe when taken under the protection of the farmer. But this establishment of a variation is not an everyday circumstance in the life of a species, it occurs only now and then: for a hundred to one, a thousand to one, or even a million to one, the best thing is to be typical of the species, to be a conservative, a true chip of the old block. Many species, like the housefly and cockroach, have come down to us practically unaltered since geological times, and the changes occurring in most species only occur with extreme slowness.

Living forms are, therefore, not only capable of variation, but by sexual conjugation these variations tend, as it were, continually to be brought back into the fold. By sexual conjugation we have the possibility of the long continuance of a type when it has adapted itself fully to its environment; by variation we have a means of adaptation to a new or changing environment. Were it not for conjugation we should not find living forms existing in genera and species. With asexual reproduction we should have an infinite number of varieties, each of these giving rise, in course of time, to new ones. With conjugation we have the inter-action of individuals upon one another, with the formation of progeny which, on the whole, tends to a mean; and among individuals capable of thus conjugating, the resemblance between them is maintained, and they form a group recognisable by common characters.

I am convinced by many personal conversations that the facts relating to chemical combinations have greatly influenced the minds of biologists, and have led them to accept increased variation as the *rôle* of conjugation. The facts of chemistry are better established and more easily understood than the facts with which we have to deal; and not unnaturally we frequently turn to them and try to arrange and interpret our facts by the side of these. Much good may come of this method provided we remember that living matter exhibits phenomena which non-living matter does not, for a phenomenon in chemistry may sometimes lead to the discovery of a similar one in biology by setting us to look for it. We have, however, no warrant for assuming that we shall find all chemical phenomena repeated in biology. No

clear-thinking biologist will, when it is thus put to him, assert that because element A and element B produce a compound C, totally unlike either A or B, that two conjugating individuals will do the same. This is obviously not the result, and the biological facts must therefore be taken and studied by themselves. These facts show that when two individuals conjugate, their offspring tends to blend their qualities, as when the cross between the negro and the white man gives rise to offspring of an intermediate shade. Even where a quality appears, like the colour of the eye, to be transmitted altogether or not at all, Galton remarks that in these cases the tendency to blend is never absolutely excluded.[1]

The plant or animal grows from the fertilised ovum, or from the cutting, and in the case of some animals from an egg which has not been fertilised at all. Here by asexual cell-division arise two cells, which in the case of many animals vary slightly from each other; their progeny continue this variation again and again, until as a result such cells are reached as those of the brain, the blood, the skin, the liver, and a hundred others. Embryology is a study of deviating lines of variation from the fertilised ovum, from which, by asexual reproduction, in the course of a few weeks, and in some animals in a few days, we may obtain types totally dissimilar to each other. This has always appeared to me to be the most striking example of variation in existence, and we note its occurrence in association with asexual reproduction.

It is generally admitted that conjugation between members of the same family fails to produce as vigorous a stock as crossing between members of different families. Animals that interbreed are proverbially delicate and wanting in physique, and this condition reminds us of the infusoria of Maupas, which were kept from conjugating with infusoria of other families and which perpetuated themselves asexually. Now, I do not see how this lack of vigour, which is an outstanding feature of asexual reproduction and inbreeding, can be explained on Weismann's theory. Although the environmental conditions of life in a warren are the same to-day as they will be in twenty years, yet the interbred progeny of a pair of rabbits will seriously deteriorate and probably die out during that time.

There must be something conservative in the act of crossing, something which keeps up that vigour and vitality which is lost without it. Now, this is easily explained if we consider the question a little more closely, and it may assist us if we examine the family histories of those of our acquaintances with which we are most familiar. We know more as to the causes of lack of vigour in our own species than in any other; human pathology has advanced with wonderful strides, and we have many facts to go upon. We learn that there are very few families without some constitutional weakness. Some are consumptive, others have a tendency to gout, etc.

[1] *Op. cit.*

We know as a fact, that if a consumptive marries with one of another family without that tendency, the chances are far better for the children than if he married, say, a first cousin. The same applies to insanity, and, as far as we know, to every constitutional weakness. It follows from this that what we may term pathological variations will tend to perpetuate themselves either by asexual reproduction, or, what comes to the same thing, by inbreeding. Crossing preserves the progeny, but does so by approximating the progeny to the mid-species. Whereas a scrofulous or a neurotic family inbred for several generations would suffer absolute extinction, even two such unfavourable types might manage to survive by crossing, for some of the progeny would probably so far approximate the mid-species as to be neither insane nor scrofulous. It is reasonable to suppose that when we know more of pathology, we may have something definite to say about the weakness which causes the potato to fall a prey to disease, and the infusoria to perish, unless crossed with other races. In the meanwhile, we recognise that there is a weakness, and we know of its existence in higher types, where we have studied it more fully.

May we not sum up the argument in a few words as follows? Variation is a function of all methods of reproduction, and the most marked cases of variation are seen in the ontogeny of a single individual, where the diverse tissues all arise by asexual divisions of a single cell. Conjugation, or sexual reproduction, brings the progeny to the mid-type, so that a thousand pugs, cats, mice, or men all more or less resemble each other, and their qualities may be plotted out in simple curves. This is not the case with asexual division, for here each product parts company with and is uninfluenced by the rest of its relations. This conservation of the type brought about by sexual conjugation is an outstanding character of undeniable importance, and preserves a species where the environment is uniform.

J. B. Haycraft.

University College, Cardiff.

III.

The "Exposition de Madagascar" at the Jardin des Plantes.

THE Professors at the Jardin des Plantes have taken the opportunity of the present enthusiasm of the French about their "new Colony" of Madagascar to put together a collection of the natural history of that island which well illustrates its many strange and peculiar features. The "Exposition de Madagascar" has been arranged in two rooms in the new gallery of the Musée d'Histoire Naturelle, under the supervision, we believe, of Mr. Alfred Grandidier, whose name is well known as that of our chief scientific authority upon the island.

Commencing with the mammals, the first object that claims attention is the splendid series of lemurs—one of the most characteristic families of the Malagasy mammal-fauna. All the numerous species of this group are illustrated by one or more specimens, and the exact range of all the species, which are in most cases representative of each other in different districts, is shown in a small map attached to it. The carnivores and rodents succeed, and are treated of in a similar manner. The collection of birds, which follows next, is also very complete, the French National Museum being unrivalled as regards its wealth in this branch of the Madagascar fauna. It is arranged according to the system and nomenclature of the splendid volumes on the birds of the island which Mr. Grandidier has published in his great work. Among the reptiles, the chameleons claim particular notice, as specially characteristic of the animal life of Madagascar. Of these strange arboreal lizards, of which some fifty or sixty are known to science, thirty-one are found in various parts of Madagascar and its adjacent islands. All are here exhibited, from the gigantic *Chamæleon oustaleti*, with its body a foot long, to the minute *Brookesia tuberculata*, scarcely an inch in length. With the fresh-water fishes, which follow the reptiles, are concluded the series of Madagascar vertebrates, and then come the land-shells, insects, and other invertebrates.

The extinct fauna of Madagascar, in which so many important discoveries have recently been made, is not less well illustrated in the "Exposition" than the modern phase of life. In the first place may

be noticed a nearly complete mounted skeleton of the former hippopotamus of Madagascar, *Hippopotamus lemorlei*, which betrays perhaps more than any other known object the ancient connection of Madagascar with the African Continent. Splendid specimens of the extinct gigantic tortoises, *Testudo grandidieri* and *Testudo abrupta*, are likewise shown, and numerous other fossils. A large series of the remains of the Aepyornithes—the extinct ratite birds of Madagascar, and several of their enormous eggs attract our attention. Diagrams of the restored skeletons of two species of these gigantic creatures show us that *Aepyornis ingens* must have been about nine feet high, and *Ae. mulleri* about six feet. But we believe these species were not quite the largest of this wonderful Order of birds. It appears that the bones of the Aepyornithes are mostly found in the interior, while the eggs are dug up in the sands of the seashore. This would seem to indicate that these birds, like some of the Megapodes, resorted to the seashore to lay their eggs, and probably left them to be hatched out in the hot sand. This theory will perhaps account for the eggs being so much larger in proportionate size than those of any other known birds. It was advisable that the chick, deprived of parental care, should come to a full degree of development before it issued from the egg-shell.

Besides the objects that have been particularly noticed there will be found in this exhibition sets of plants, native costumes, numbers of photographs of the various tribes of Madagascar and of its scenery, and a large selection of plates and drawings taken from Mr. Grandidier's great work. No naturalist who goes to Paris should fail to pay a visit to the "Exposition de Madagascar."

P. L. Sclater.

IV.

On the Relation of Philosophy to Natural Science.[1]

IN explanation of the above title, I may mention that a prize for the best essay on the subject was offered by the Philosophical Society of Berlin in 1891. The question not being personal, but purely scientific, is, however, open to independent enquirers at any time.

Some forty years ago Mr. Herbert Spencer commenced a "System of Synthetic Philosophy," and in a comparatively modern edition (the fifth, 1887) of the "First Principles," chapter i., part ii., p. 127, under the heading "Philosophy Defined," he has done good service in attempting to give a definition of Philosophy. After some preliminary remarks, he says:—

"The truths of philosophy thus bear the same relation to the highest scientific truths that each of these bears to lower scientific truths. As each widest generalisation of science comprehends and consolidates the narrower generalisations of its own division, so the generalisations of philosophy comprehend and consolidate the widest generalisations of science. It is, therefore, a knowledge the extreme opposite in kind to that which experience first accumulates. It is the final product of that process which begins with a mere colligation of crude observations, goes on establishing propositions that are broader and more separated from particular cases, and ends in universal propositions. Or to bring the definition to its simplest and clearest form, Knowledge of the lowest kind is un-unified knowledge; science is partially unified knowledge; Philosophy is completely unified knowledge." ("First Principles," pp. 133, 134.)

According to this definition, it appears that philosophy purports to be a development of science up to complete unification; or that a system of philosophy is understood to include science as an integral part of itself; and, therefore, the relation of philosophy to science simply represents the relation of knowledge completely unified to knowledge partially unified. It appears, then, that the answer to the prize essay in question is given in these few words, in terms of Mr. Spencer's definition of philosophy.

Certain fundamental intuitions, Mr. Spencer remarks, that are

[1] "Das Verhältniss der Philosophie zu dem empirischen Wissenschaft von der Natur."

"essential to the process of thinking" must be assumed as true *provisionally*, leaving the assumption of their infallibility to be justified by the "congruity of the results reached through the assumption of them," or by showing that there is an agreement between the experiences they lead us to anticipate and the actual experiences. These ultimate intuitions constitute the "Data of Philosophy"; and they are, first, that fundamental relation between Subject and Object "taken for granted in every act of daily life, and assumed as beyond question in scientific investigations of all orders," secondly, and connected with the foregoing, the primary truth of the "Persistence of Force." Such, then, is the foundation of Mr. Herbert Spencer's System of Philosophy, which he defends against the adverse views of some philosophical authors[1]; and the same basis is adopted by science.

In respect to the "fundamental intuitions" mentioned above, it may be observed that these "intuitions" themselves are, according to Mr. Spencer, derived from ancestral experiences, or inherited from the collective experiences of the whole line of organised beings from whom (on the hypothesis of evolution) man is descended. Therefore they are ingrained in the organism, and are ineradicable.

The careful tracing of one general formula of evolution applicable to the changes undergone by all orders of existences appears to be the chief contribution to the unification of knowledge which Mr. Spencer makes in the "First Principles." The processes of development which evolution follows in the several realms of inorganic, organic, and super-organic existences, comprising even art and science, are, says Mr. Spencer, analogous in their main stages. Wolff and Von Baer are mentioned as contributing the germ of the formula which Mr. Spencer has developed and applied to existences of all orders, consistently with a previous conviction of the prevalence of "unity of method throughout nature." ("First Principles," pp. 337, 359, etc.)

Mr. Spencer's first communication on the subject was in the form of an essay published in the *Westminster Review* for April, 1857, under the title, "Progress: its Law and Cause." The formula as given in the "First Principles," p. 396, may be appended: "Evolution is an integration of matter and concomitant dissipation of motion, during which the matter passes from an indefinite, incoherent homogeneity to a definite, coherent heterogeneity, and during which the retained motion undergoes a parallel transformation."

The condensed shape in which this formula is presented may at first sight convey an inadequate idea of its import, in the absence of examples of its application. It will not, of course, affect the validity of the doctrine of evolution itself, even if some should doubt whether the applicability of the above formula is so universal as is contended. It may be superfluous to remark that the doctrine of evolution merely

[1] "Principles of Psychology," vol. ii., pp. 312 et sqq.

teaches that processes take place according to natural laws. Although the broad and general terms in which the above formula is worded may make its precise application to detail a thing scarcely to be expected, it may none the less be viewed as a valuable contribution to the coördination of the procedure of natural processes, where we should otherwise be left in the dark. That the author also uses his formula as an aid to organise, classify, and integrate the subdivisions of his works into a coherent system is manifest, philosophy being a super-organic product in a certain sense "evolved."

How is it, it may be asked, that while the formula of evolution implies that heterogeneity or complexity is a concomitant of progress, nevertheless in the invention of machinery, simplicity and not complexity is made the object of study? Here at least simplification is one phase of progress, and simplicity being unique of its kind, is not easy to discover.

An analysis may, however, remove this apparent contradiction. A modern machine, such as a locomotive or a steamship, is more complex or heterogeneous than that of an older type; not, however, that simplification is less studied than formerly, but that the machine has to fulfil additional functions, for which, of course, additional mechanism is required. It does not, however, follow that the mechanism itself is wanting in simplicity, or that the simplicity aimed at has not been gained. The complexity or heterogeneity here consists in the variety of machines, some subsidiary, not in the complication of any particular piece of mechanism. In fact any suggestion for simplifying the mechanism is always welcomed. Machines, like the higher animals, have advanced in heterogeneity on account of the multiplication of the separate functions attendant on a higher degree of civilisation. Hence it appears that the formula of evolution applies, provided all the conditions are allowed for.

Referring to the proposed definition of philosophy, Mr. Spencer observes:—"Science means merely the family of the sciences—stands for nothing more than the sum of knowledge formed of their contributions; and ignores the knowledge constituted by the *fusion* of all these contributions into a whole. As usage has defined it, science consists of truths existing more or less separated, and does not recognise these truths as entirely integrated." ("First Principles," p. 132.)

This seems to imply that although between philosophy and science no sharp line of demarcation exists, yet the distinctive name "Philosophy" is convenient for indicating the contents of a volume bearing that title. If the volume form part of a "System of Philosophy," it will constitute a unit in a collective treatise, whose main object is the complete unification of the knowledge partially unified by science; the more abstract reasoning required for extreme generalisation tending to become a specialised field of investigation, even if the method involved be the same as in science.

This pursuit of scientific investigation under a different name,

"Philosophy," without any change of method, has probably been the cause of some confusion as to what "Philosophy" is; and to define its relation to Science was, in fact, the motive for giving it as the subject of the prize essay, and the incentive to the thoughts of which this paper is the outcome.

It might be said that if philosophic authors appear less precise, and possibly more bold, in their inferences, they are freer from certain prejudices. No "battle" should have been required over evolution surely, in order to introduce it to the scientific world. Evolution teaches no more than that facts take place in accordance with natural causes. There is no supposition of supernatural interference in order to maintain the theory of gravitation or the movements of the planets, even if Kepler conjectured something of the kind. Why, then, suppose supernatural interference in molecular movements, or in connection with evolutionary phenomena? Here experiment is obviously not excluded; the evolutionary changes converting wild animals into domestic ones have been produced by ourselves. Why imagine, then, that the effects generally classed under evolution should be exceptional, in the respect of possibly deviating from the laws of nature?

Some of the scientifically cultured may be unacquainted with Hume's investigation concerning the limits of scientific enquiry, developed with greater precision in Mr. Spencer's analysis respecting the question of origin and the mystery surrounding the universe ("First Principles," pp. 30–36). The researches of philosophy are certainly an excellent school for the elimination of any (possibly partly inherited) bias, which physics, chemistry, or analogous studies would leave untouched. It will probably be conceded that some philosophical Reviews (or "Addresses") have not been without service in this direction.

The late Professor von Helmholtz once observed that in some respects the modern telescope surpasses the eye in optical qualities. To endorse this does not necessarily imply that the adaptation of the eye is unfitted for its purpose. Nevertheless, it is possible to understand how art can occasionally surpass nature, especially when science and art combine, they being, in the case of the telescope, the natural product of an unbroken process of evolution—where the evolution of the human brain was a preliminary stage. The telescope, therefore, represents a super-organic product, a secondary or more advanced stage of the evolutionary procedure. Consequently, it appears that a superior refinement in some directions may be expected, where the eye itself might be left behind.

Super-organic evolution seems to be of some importance as an idea, since nature, depreciated by ignoring this point of view, may thereby come to be esteemed in a higher degree. By the conception of super-organic evolution, we realise, for instance, how the great achievements of science, art of various kinds, poetry, music, etc.,

constitute part of nature, and we ourselves part of the universe, comprised under nature, which we raise by our endeavours and by this view.

By omitting to realise the fact of Man being a part of the universe, not merely situate there, we lose sight of a lever, by which intelligence—from its dynamical[1] side—operates upon the universe. In this sense Man becomes independent (*i.e.*, not dominated tyrannically by the universe, without reciprocal powers of action), acquiring all the privileges attached to membership of the community of nature.

It appears accordingly that free-will exists in the only sense conceivable. Those who contend that more freedom than this is desirable would do a service by trying to define that condition they would wish in preference to see prevailing. We receive our existence gratuitously, evolved out of the universe without pay or cost; and we may expect to rough it a little with the chance of contributing to the dignity of nature by our career. In the past rise of man through a long train of progressive evolution, as in the case of life generally, the "inner relations" being evolved from the "outer relations" (environment), are thereby made best adapted for the "outer relations," or brought into accord with them by the most fitting method conceivable.

Hamburg. S. Tolver Preston.

[1] The material side of intelligence is, of course, represented by the brain, the constituent matter of which is in a state of active motion, pervaded by the light-conveying ether.

V.

Morphology at the National Museum.

WHEN, in 1862, Professor Owen, afterwards Sir Richard Owen, published a scheme for the erection of a National Museum of Natural History at South Kensington, he designed that in the centre of the building there should be a lecture theatre, and above it a circular domed museum of 100 feet diameter, which would "serve for the reception of an Elementary Collection, illustrating the characters of the Provinces, Classes, Orders, and Genera of the Animal Kingdom." The series of specimens proposed to be there displayed were to be of such a nature as would be most profitably shown to, and studied by, the wage-classes after the hours of work. The specimens were to be accompanied by instructive labels, and, where necessary, diagrams; and this, he urged, "would best fulfil the wish of the Legislature as expressed by the 'Report of the Select Committee on Public Institutions' of 1860, and reiterated by honourable members in successive annual debates on the British Museum."

Later, it was decided to dispense with the lecture theatre, but the idea of an introductory or index museum was firmly adhered to, and the recesses or bays on the east and west sides of the entrance hall were to be reserved for the purpose. The first steps were taken towards the realisation of this project as soon as the cases were ready to receive specimens, and in 1882 a "Guide to the Index Museum, Aves," eight pages in length, was issued and sold in the Museum. This guide is very interesting as showing what were the exact lines on which Owen intended to elaborate his scheme of an introductory series. The pamphlet begins in very popular language, but as soon as technical terms are introduced the character of the text changes, and such passages, for instance, as the description of the brain of the bird are certainly not adapted to the intellect of the general public. Although the conception of the idea of an Index Museum occurred as far back as 1860, the collection cannot be said to have received actual shape until Sir William Flower succeeded to the directorship of the Museum. The first real impetus to the work was given when, in 1884, he appointed Mr. R. S. Wray, B.Sc., who unhappily succumbed to pulmonary phthisis in 1889, to assist him in this work.

The present scope of the Index Museum may be gathered from

the "General Guide to the British Museum, Natural History," in which it is stated that the whole of the specimens contained in the museum are arranged in three sections,—a reserve series, not exhibited, but accessible to specialists and investigators, a systematic series exhibited in the various galleries of the museum, where the visitor can identify and name his own specimens without recourse to assistance from the officials, and, thirdly, an introductory or index series, in which the leading features of structure and development are demonstrated, and the terms used in systematic works are explained by means of illustrative examples. The five bays or recesses on the west side of the hall are devoted to vertebrate morphology, while, on the east side, three bays are set apart for botanical collections, and the remaining two for invertebrate animals.

Although the work of forming this Index Collection has been progressing continuously for the past eleven years, there is still a large amount of space unoccupied in the cases, which not only points to the great care that is exercised in the selection and preparation of the specimens, but also shows what an extraordinary length of time pioneer ventures of this kind require for their completion. It is only natural to suppose that during this long time improvements have constantly suggested themselves, and have been adopted, and this accounts, to a large extent, for the slight want of uniformity which may be observed between the earlier and the later series of preparations. Not only is it necessary to admit that the present Index Collection is adapted to the requirements of the student rather than to the edification of the wage-classes as Owen had intended, but also that the more recent additions to the collection appeal to a more advanced type of student than the earlier preparations.

This is especially apparent in the wording of the labels. Thus, as examples of some of the earlier labels, we read "The heart is the central organ of the circulation, and acts as a suction pump in collecting blood from all parts of the body, etc.," and "The skeleton is a system of hard parts forming a framework which supports and protects the softer and more delicate organs and tissues of the body, etc.," whereas in descriptions of the later series, *e.g.*, that of the tendons of the bird's foot, the language is far more technical.

This studying of the interests of the student rather than of the general public has been adversely criticised by more than one educational authority, on the ground that the student can find all the facts here illustrated mentioned in his text-books, and that the Index Museum, instead of constituting an introduction to the systematic collections in the galleries, is developing into a "college museum."

That the latter statement is not without foundation is evident from the fact that educational museums are now being modelled on the same plan in different parts of the country, at the Tonbridge School Museum, for instance, and even abroad, as at the Columbia College, New York; and on somewhat similar lines Professor Ray

Lankester is reörganising the zoological collections in the Oxford University Museum. Yet an assemblage of specimens designed to illustrate only those characters at present employed for purposes of classification would, while assisting the tyro-systematist in the identification of genera and species, fail to suggest in what directions the sphere of taxonomic observation might be extended. Systematic zoology and botany are very largely mechanical, and are based on the combinations of a limited number of characters which are found to differ sufficiently for the purpose in the various families, genera, and species. The ultimate aim of the zoologist and botanist, however, is, or should be, not the description of so many new species in a lifetime, but the grouping of animals and plants according to their natural affinities, and for this purpose a wider knowledge of morphology is necessary. Limitation of the number of diagnostic characters is fatal to the advancement of systematic work. There are, it is true, many organs—the viscera of animals, for instance—which will probably never be made use of for the identification of species, because type-specimens are usually disembowelled before finding their way to a museum; but, at the same time, no systematist would be justified in issuing a new system of classification while ignoring the evidence of natural affinity to be afforded by internal organs. With regard to the former objection, there are surely very few who would maintain that the student derives no more benefit from the examination of a collection of anatomical preparations than he would from a text-book, however well illustrated. A figure, whether woodcut or coloured plate, always falls far short of the original by the loss of the third dimension of space: the examination of a prepared dissection is in educational value second only to the dissection of the parts by the student himself.

In such an educational collection, not only do the several classes of animals call for different methods of treatment, but the amount of space to be allotted to any one system of organs varies very considerably in the different classes. Thus, while a whole table-case is occupied by preparations of mammalian teeth, a few square inches suffice for the same organs in birds, and whereas the exo-skeleton of Amphibia is efficiently represented in an area of less than two square feet, the corresponding system in Mollusca, constituting as it does the basis of that special branch of science, conchology, calls for an inordinate amount of space. In the case of Amphibia, no one system of organs requires an exceptional amount of space for its due exposition, and the recently completed series of osteological and anatomical preparations illustrating the morphology of the Amphibia may therefore be regarded as typical and representative of the whole Index Collection.

This series is contained in a wall-case in the fourth bay on the west side of the entrance hall. The preparations are fixed to a board or facia, three feet high and seven feet wide, placed vertically so as to

be parallel to the glass. It is a distinct advantage, under all circumstances, to have the front and back of a case parallel, but more especially is this desirable when wet preparations are to be exhibited. The case is of considerable depth, but, since there are no large specimens in the series, the facia is brought forward quite close to the glass, and every specimen is thus within convenient distance of the spectator. (Plate xix.)

The preparations are arranged in eleven upright columns, the broadest of which is ten inches and the narrowest five inches in width. The columns are marked off from one another by narrow strips of polished mahogany, and in each column the four orders of Amphibia are separated in a similar manner.

The tablets on which the specimens are mounted are covered with a neutral grey paper, and, since osteological preparations show to so much better advantage on a dark background, these are placed on rectangular black papers cut to such a size as to leave a $\frac{5}{8}$-inch grey border. The value of the grey border in relieving what would otherwise be a continuous black surface cannot be over-estimated; the total effect is not only more attractive and pleasing to the eye, but that feeling of depression which a large expanse of black surface engenders is removed.

Since the study of morphology involves palæontology quite as much as zoology, as regards those parts of the body which can be preserved to us as fossils, the remains of extinct Amphibia are treated in exactly the same manner as the hard parts of their living relatives.

The collection owes a great deal of its completeness to the fact that the practical difficulties of exhibiting spirit specimens and dried preparations side by side have been overcome in a manner which, if not perfect, marks a distinct advance on the methods of museum exposition previously in vogue. The distressing refraction which was so great a disadvantage in the use of oval or cylindrical bottles is avoided by the employment of rectangular glass jars, which are manufactured now far more neatly than when, not many years ago, they were first introduced into museums. The preservative employed is in all cases 70 per cent. alcohol. Great advantages have recently been claimed for an aqueous solution of formic aldehyd, but having regard to the chemical instability of this substance it is deemed prudent to wait, before employing it as a preservative, until more is known about its behaviour when exposed for any length of time to bright sunlight. The background of each spirit specimen is white or black according to the predominance of dark or light colours in the dissection. Specimens dissected from the dorsal or from the ventral surface are mounted with the snout uppermost, but in side dissections the head points to the left.

Every specimen is exhibited for a definite purpose, which is explained either in the label of the preparation or in that of the series of which it forms part. In the dry preparations each of the more

important structures is pointed out by a narrow strip of paper, to the outer end of which a label bearing the name of the part is attached. A difficulty is experienced when applying this method of demonstration to spirit specimens. If the paper pointer attached to the label is to actually touch the structure which it is desired to indicate, the label must be sealed up in the spirit with the dissection. This method has been adopted in the preparation of the portal veins of the frog, in the last column but two; but, even disregarding the practical difficulties of so affixing the labels to a flexible dissection that in the finished preparation they may be perfectly horizontal (and it will be observed that nowhere in the series is the eye offended by obliquely sloping labels), the transparency of the paper in spirit and the subsequent discoloration render the labels less striking than those attached to osteological and other dry preparations. In all the dissections, with the exception of that just mentioned, the labels are affixed, not to the dissection, but to the front surface of the glass jar in which it is mounted, and, although the paper pointers cannot touch the part indicated, yet in very few cases is there any uncertainty as to what is specially intended to be shown, blood-vessels being injected, and nerves and small ganglia being made more conspicuous by strips of black paper placed beneath them. In all cases the free extremity of the pointer is exactly over the structure pointed at when the axis of vision is normal to the surface of the glass at that point, that is to say, when the free end of the pointer is in the centre of the reflected image of the one eye to which, for this purpose, the observer must limit himself.

Not the least important aim of the educationalist is the attainment of such methods of imparting instruction as shall enable the student to assimilate information with the least possible conscious effort. Any measure which is calculated to reduce the mental wear and tear is an important step towards the perfecting of our system of education. It will be noticed that in this series there are no long labels likely to weary or disgust the student. The labels are kept as short and concise as is consistent with accuracy, since it has been observed that, while a visitor will seldom take the trouble to read through a label of twenty lines, he will not hesitate to do so if that label be divided into four or five parts interspersed among the specimens.[1] The information furnished by a label at the top of a tablet is of a general nature and applies to the group of specimens below, whereas the label beneath each specimen has particular reference to that preparation only.

Specimens, whether dry or in spirit, too small to be labelled in the usual way, are accompanied by an enlarged drawing, and the

[1] In the August number of this Journal Mr. S. F. Harmer, reviewing the Fifth Annual Report of the Proceedings of the Museums Association, very justly condemns the employment of lengthy labels in museums, and furnishes one or two sound arguments in support of his position.

labels are affixed to the several parts of the drawing. When fossil specimens are either not obtainable on account of their rarity, or are too large for exhibition in the series, their place is taken by labelled drawings; and when the outline or position of any structure is not sufficiently obvious, *e.g.*, the sutures of bones, the teeth of small skulls, and the organs of the lateral line, recourse is had to the judicious application of a little bright colour.

It will be noticed that the classification adopted is alternately systematic and anatomical. Thus, the Vertebrata are first divided into the classes, Birds, Reptiles, Amphibians, etc., and the preparations illustrating Amphibian morphology are arranged according to the different systems of organs, Integument, Skull, Respiratory System, etc. The specimens in each of these divisions are grouped under the ordinal heads Anura, Urodela, etc., and in many cases structural peculiarities serve once more for the arrangement of the preparations in each order.

INTEGUMENT.—The first column is devoted to an exposition of the characters of the integument: the glandular nature of the skin is alluded to, and the periodic shedding of the outer layers of the epidermis is illustrated by the slough of a newt mounted in spirit. 'An epidermal exoskeleton is absent except in the Japanese Salamander (*Onychodactylus*) and in the Cape Toad (*Xenopus*), which are provided with claws.' Examples are therefore furnished of the feet of these two amphibians. 'The dermal exoskeleton is also but little developed in living Amphibia. In *Ceratophrys* among the Anura there is a bony plate behind the skull and in some of the Cæcilians there are small cycloid scales imbedded in the skin.' A complete skeleton of *Ceratophrys* shows the form and position of this dermal ossification; and a portion of the skin of *Ichthyophis*, a few isolated scales mounted on black paper, and an enlarged drawing of one of these scales illustrate the second form of dermal exoskeleton. 'In the Labyrinthodontia bony scutes are frequently present on the ventral aspect of the body,' a statement which is illustrated by a drawing of the ventral scutes of *Cricotus*.

VERTEBRAL COLUMN.—'The vertebral column of Anura is usually composed of nine vertebræ and an unsegmented urostyle.' The series commences with two vertebral columns of *Rana guppyi*, one showing the ventral surface and with the vertebræ articulated, the other disarticulated and with the articular surfaces of the centra coloured brown and those of the zygapophyses green. 'The vertebræ of Anura are mostly procœlous and devoid of free ribs, but in the *Discoglossidæ* and the *Aglossa* they are opisthocœlous, and in the former family the anterior vertebræ are provided with distinct ribs.' Examples: *Discoglossus* and *Xenopus*. Then follow a series of five vertebral columns of Anura showing the various degrees of expansion of the sacral diapophyses. The short vertebral columns of the Anura are mounted whole, but in the other orders selected vertebræ only are

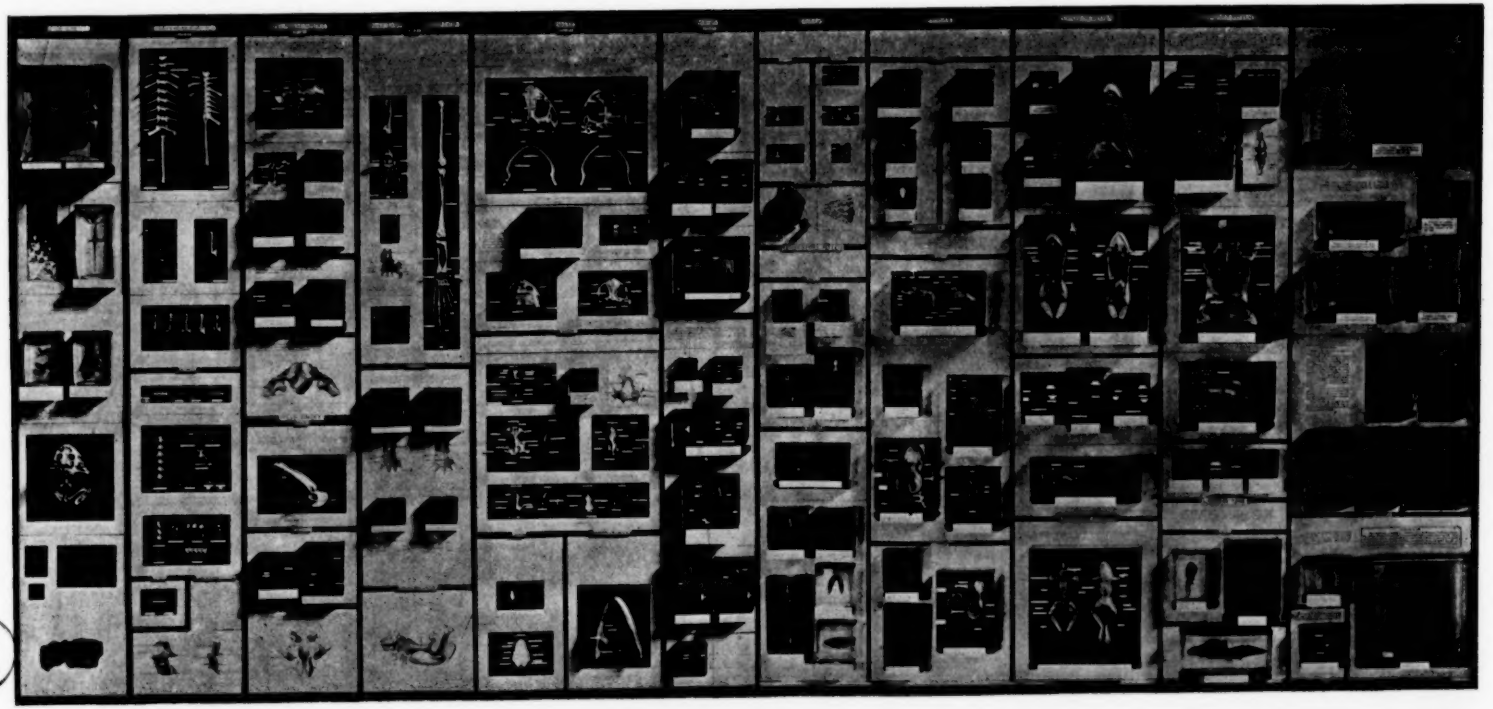
shown. *Molge watlii* is chosen to illustrate the opisthocœlous vertebræ of the Salamandridæ, and as examples of amphicœlous vertebræ those of *Menopoma* and *Siren* are exhibited. The amphicœlous character of the vertebræ of the Apoda and the two-headed nature of the ribs are shown by selected vertebræ of *Ichthyophis*. 'The vertebræ of Labyrinthodontia may be fully ossified and amphicœlous, or may consist of a neural arch and a ring-like centrum and intercentrum (such *embolomerous* vertebræ occur chiefly in the caudal region), or may be composed of a neural arch, a pair of pleurocentra, and an intercentrum (*rachitomous* type, found mostly in the trunk region).' Drawings of restored vertebræ of *Loxomma* and *Eryops* illustrate these two types.

Pectoral Girdle.—'In the Anura there is a coracoidal fenestration between the precoracoid, the epicoracoid and the coracoid. The epicoracoid cartilages overlap in the *Arcifera*, but fuse in the ventral median line in the *Firmisternia*. Closely applied to the precoracoid cartilage is a membrane bone, the clavicle.' 'In the Urodela a scapula, a coracoid and a precoracoid can be distinguished. The coracoids overlap in the ventral median line and the sternum is unossified.' 'In the Labyrinthodontia there is a dermal thoracic buckler composed of a median plate (interclavicle) and two lateral plates (clavicles). The pectoral girdle proper is probably largely cartilaginous.' The examples furnished are, for Anura, *Rana*, *Bufo*, *Discoglossus*, *Callula*, and *Xenopus;* for Urodela, *Salamandra* and *Menopoma*; and for the Labyrinthodontia, a drawing of a partly-restored pectoral girdle of *Actinodon*.

Pelvic Girdle.—'In the Anura the ilia are greatly elongated and backwardly rotated. The pubes are usually unossified. As in other Amphibia there is no obturator foramen.' 'In the Urodela the ilia are set at right angles to the vertebral column; the pubes are usually cartilaginous and there is an epipubic cartilage.' 'In the Labyrinthodontia the ilium is vertical as in Urodela. The pubis is ossified but does not enter into the formation of the acetabulum.' As illustrations are given, *Rana* as representing the Anura, *Salamandra* and *Menopoma* as examples of the higher and lower Urodela, and a drawing of a restored pelvis of *Mastodonsaurus* to represent the Labyrinthodontia.

Limb Skeleton.—'In the forelimb of Anura the radius and ulna are fused, the pollex is rudimentary, there are two centralia in the carpus, and the intermedium and carpale 5 are absent.' Examples: *Rana guppyi*, *Discoglossus*, and *Rhacophorus*, the latter to show the so-called supernumerary phalanx. 'The hind-limb of Anura is elongated and modified for leaping or swimming. The tibia and fibula are fused, the astragalus and calcaneum are elongated, and the intermedium and tarsalia 4 and 5 are absent. There is a prehallux of two or more segments.' Example: *Rana guppyi*.

'In the majority of Urodela the fore-limb is tetra- and the hind-



CASE IN THE INDEX COLLECTION AT THE NATURAL HISTORY MUSEUM, ILLUSTRATING THE MORPHOLOGY OF THE AMPHIBIA.
By kind permission of Sir William Flower, K.C.B.

B. Deliagana, Sc.] [*A. Gepp, Photo.*

AMERICAN MUSEUM OF NATURAL HISTORY

limb penta-dactyle, but the number of digits may be reduced. The carpus and tarsus either remain cartilaginous or are but slightly ossified.' Examples: *Salamandra* and *Amphiuma*. In the Labyrinthodontia the limbs are usually pentadactyle and the pectoral shorter than the pelvic. The carpus and tarsus are usually cartilaginous, and in some cases three centralia can be distinguished.' Example: drawing of fore-limb of *Eryops*.

SKULL.—'In the Anura the skull is short and wide and the mandibular articulation is thrown far back. As in other Amphibia there are two occipital condyles and the basioccipital and supra-occipital are small and unossified. The parietals are confluent with the frontals and the palatines are set transversely to the axis of the skull. Mentomeckelian bones are present in the mandible in many families of the Anura.' 'Cartilage in the skull of Anura is largely persistent, but ossifies to form a median sphenethmoid and a paired proötic and exoccipital containing the membranous labyrinth of the ear. The palato-quadrate cartilage is complete and the pterygoid, which arises as a membrane bone, invades the subjacent cartilage.' The former label is illustrated by two exceedingly fine specimens of the skull of *Rana guppyi*, each not less than three inches across, the latter by a spirit preparation of the chondrocranium and Meckel's cartilage of *Rana esculenta*. Then follow skulls of *Hyla* and *Alytes*, showing the frontoparietal fontanelle, a skull of *Calyptocephalus*, showing the roofing-in of the supratemporal fossa, and the skull of *Pipa* with the following description: 'The cranium is excessively flattened, and contains but little cartilage. There is no sphenethmoid, the quadrate is well developed and the squamosal is small.'

'In the Urodela the parasphenoid is of large size and the palatines are parallel to the axis of the skull. The quadrate is more or less ossified, the quadrato-jugal is absent and the lower temporal arch incomplete.' The skulls exhibited are those of *Salamandra*, *Menopoma*, *Amphiuma*, and *Siren*. 'In the Apoda the skull is remarkable for the completeness of its roof and the large size of the bones. The chondrocranium is greatly reduced.' Example: *Ichthyophis*. 'In the Labyrinthodontia the temporal region of the skull is completely roofed over by the postorbital and supratemporal bones. There are large and distinct epiotics, a parietal foramen, and paired dermo-supra-occipitals. The surface also is sculptured and channelled by mucous grooves.' A plaster cast of the skull of *Bothriceps*, presenting the palatal surface, does duty here, and attention is called to the cast of the skull of *Loxomma*, on the shelf below, the parts of the dorsal surface of which are labelled.

VISCERAL SKELETON.—'In the Anura the hyoid arch is slender, and confluent anteriorly with the large basi-hyo-branchial cartilage. Of the four branchial arches of the tadpole the fourth persists in the adult as the thyrohyal. In *Pipa* and *Xenopus* the fused first and second branchials also persist, and the thyrohyal is intimately

connected with the enlarged larynx.' The examples furnished are *Rana guppyi* showing the thyrohyals alone ossified, *Bombinator* with a paired ossification in the basi-hyo-branchial, *Pipa* showing the absence of the hyoid arch, and *Xenopus*. It is intended to add to this series the branchial skeleton of a tadpole of one of the commoner Anura. 'In the Urodela the hyoid arch consists of a large ceratohyal and a hypohyal. There are usually four branchial arches, the first two only of which persist in adult Salamandridæ. The median elements consist of a basi-hyo-branchial and a second basi-branchial.' The series comprises *Salamandra* and *Amblystoma*, larva and adult, showing the disappearance of the last two arches during metamorphosis, *Cryptobranchus* showing the hyo-mandibular cartilage, *Amphiuma* and *Siren* with four branchial arches, and *Proteus* and *Necturus* with only three.

Teeth.—'In the tadpoles of most Anura and in *Siren* the jaws are covered with a horny sheath. Teeth are rarely present in the lower jaw of Anura. The premaxilla, maxilla and vomer are usually dentigerous, and in the Urodela the palatine also. In many Labyrinthodontia the teeth are marked by longitudinal folds, which in some genera give a very complicated pattern as seen in transverse section.' The specimens in this series consist of the horny teeth of an *Alytes* tadpole, the skull of a toad showing absence of teeth, that of a frog with upper teeth present, *Salamandra* showing the vomero-palatine teeth parallel to the axis of the skull, *Amblystoma* showing how the vomero-palatine teeth are parallel to the maxillary series in the Axolotl, but are transverse to the axis of the skull in the gill-less form, the skull of *Spelerpes* showing teeth on the parasphenoid, and two teeth of *Mastodonsaurus*, with an enlarged drawing of the transverse section.

Respiratory System.—'The larvæ of almost all Amphibia are provided with gills. These coëxist with lungs in the adults of *Siren*, *Proteus* and *Necturus*, but are lost in other forms, although in *Cryptobranchus* and *Amphiuma* the fourth branchial cleft remains permanently open. The lungs are elongated in some of the Urodela but are short in the Salamanders and in the Anura. Bronchi are present in *Pipa* and *Xenopus*, and a trachea in *Cryptobranchus*, *Amphiuma* and the Apoda. The skin of Amphibia plays an important part in respiration, especially during hibernation.' By way of illustration are shown tadpoles of the frog with external and with internal gills, preparations of the lungs of *Rana* and *Xenopus*, a dissection of *Spelerpes* showing absence of both lungs and gills, preparations of *Proteus* showing presence of both lungs and gills, a larva of *Salamandra atra* with external gills, a preparation of the lungs of an adult *Salamandra*, and the head of a small specimen of *Amphiuma* showing the persistent branchial cleft.

Tongue.—'The tongue in most Anura is large and fleshy, and is attached to the floor of the mouth anteriorly while the posterior

part is free and can be rapidly protruded from the mouth. In *Pipa* and *Xenopus* however the tongue is wanting. In some Anura (*e.g.*, *Discoglossidæ*) and in the salamanders the tongue is not protrusile, and in the lower Urodela and the Apoda it is rudimentary.' Examples: *Rana*, *Bombinator*, *Bufo*, *Xenopus*, *Salamandra*, and *Spelerpes*.

Digestive System.—'The alimentary canal is simple and nearly straight in the Apoda and lower Urodela, but, in most cases, cardiac and pyloric divisions of the stomach can be distinguished, and the intestine is thrown into coils. The rectum is short and opens into a cloaca, to the ventral side of which a urinary bladder is appended. There are no definite salivary glands. The liver is usually two-lobed, and the left lobe is subdivided in Anura. The liver is elongated in the Apoda and in the more slender-bodied Urodela.' Then follow dissections of the isolated alimentary canal of the frog and salamander, and preparations of the liver of the frog, salamander, and *Proteus*. 'The larvæ or tadpoles of the Anura feed on vegetable matter, whereas the adults live on insects, worms, etc. In relation to this difference in diet the alimentary canal is not only relatively but absolutely longer in the tadpole than in the adult'; a generalisation which is illustrated by dissections of the alimentary canal of a tadpole and an adult of *Alytes*.

Vascular System.—'In the heart of Amphibia the ventricle is single but the auricle is divided by a more or less complete septum. Of the four vascular arches of the larva, the first gives off the carotid arteries and the fourth the pulmo-cutaneous arteries; the second arch persists as the aorta, while the third is lost in most cases but frequently persists in salamanders. A post-caval, an anterior abdominal and a pair of renal-portal veins are always present, but the post-cardinal veins of the larva usually atrophy in the adult.' Injected specimens of the frog and salamander, and preparations of the heart of *Rana*, *Amphiuma*, *Siren*, and *Cryptobranchus* serve to illustrate the vascular system, while a pair of dissections of the subcutaneous spaces and lymph hearts of the frog show the exceptional development which the lymphatic system attains in the Anura.

Nervous System.—'The brain of the Amphibia is elongated and without any marked flexure. The olfactory lobes are sessile and the cerebral hemispheres are large and elongated. The optic lobes are larger and more clearly marked off from one another in Anura than in Urodela. The cerebellum is a transverse bridge of variable breadth, but always small in size. The hypoglossal is usually the first spinal nerve. The dorsal and ventral nerve roots unite outside the neural arch, and the spinal ganglia are surrounded by calciferous glands.' Then follow three dissections of the nervous system of the frog, and preparations of the brain of the frog, salamander, axolotl, and *Cryptobranchus*.

Lateral Line.—'The sensory organs of the lateral line occur

in all the aquatic larvæ of Amphibia, and persist in those Urodela which lead an aquatic life, *e.g.*, *Proteus*, *Molge*. They are lost in adult Anura, except *Xenopus* and some Pelobatoids, and in those Urodela, *e.g.*, *Salamandra*, which are terrestrial when adult.' Examples: *Pelodytes* tadpole and adults of *Xenopus* and *Molge*.

Development.—'The Anura are oviparous, and the larvæ or tadpoles, when hatched, soon develop a tail provided with a fin. A pair of suckers are in some cases developed on the ventral surface behind the mouth, which latter is provided with horny teeth. Respiration is at first effected by means of three pairs of external gills, and later by internal gills, developed on the walls of the four branchial clefts. An atrial membrane grows back over the gill-clefts and, on the closure of the exhalent aperture, pulmonary respiration is definitely established. The limbs are formed comparatively late, and the tail, which is supported by a notochord and not by vertebræ, is gradually absorbed.' Below this label is a gradational series of twenty tadpoles of the common frog, showing the development from the egg up to the completion of the metamorphosis. 'The spiracle or exhalent aperture of the branchial chamber is, in most tadpoles, situated on the left side of the body, but in *Xenopus* it is paired, and in the *Discoglossidæ* it is situated on the ventral surface.' Examples: tadpoles of *Alytes*, *Rana*, *Pelobates*, and *Xenopus*.

Then follow five skeletons of *Pelobates* at different stages of development, and attention is called to the following points of interest:—'Vertebræ are not formed around that portion of the notochord which supports the large swimming tail of the tadpole, and this caudal notochord is gradually absorbed as the tail becomes reduced in size in the metamorphosis from the tadpole to the adult form. The greater part of the urostyle of the adult is formed from a splint of bone developed on the ventral surface of the notochord behind the last vertebra. There is a gradual increase in size and in the extent of ossification of the skeleton of the limbs and the limb-girdles, and the pelvis becomes connected with the vertebral column. There is also an increase in the breadth of the skull and the size of the mouth, and the branchial skeleton becomes greatly reduced.'

'The larvæ of Urodela possess external gills, which may be retained by the adult (*e.g.*, *Proteus*) or lost (newts and salamanders). The tail persists and develops complete vertebræ.' Example: larva of *Salamandra maculosa* at birth. 'The larvæ of Apoda possess external gills and a tail which is absorbed more or less completely during metamorphosis.' Example: larva of *Ichthyophis* showing external gills, tail, and yolk-sac.

At the foot of this column the dimorphism of *Amblystoma* is illustrated by the exhibition of a typical Axolotl and a perfect or gill-less form of about the same size, with the following description:—'This Amphibian is dimorphic, a condition very uncommon in verte-

brate animals. The larva is possessed of three pairs of external gills and a crested swimming tail. These larval features may be retained and the animal remain aquatic for the whole of its life (Axolotl form), or under certain condition sa metamorphosis may be passed through, and the animal, destitute of gills and with a rounded tapering tail, becomes terrestrial in habit.' The close relation existing between developmental metamorphosis and the dimorphic metamorphosis of *Amblystoma* finds for this preparation a fitting place at the close of the developmental series.

The plate illustrating this article has been prepared from a couple of photographs taken by Mr. A. Gepp, of the Botanical Department of the Museum. I offer him hearty thanks for the trouble he has taken.

W. G. Ridewood.

VI.

Oceanic Deposits Ancient and Modern.

I.—The Foraminifera.

RECENT deep-sea researches, by enabling us to understand more fully the present distribution of the oceanic faunas, have revealed many facts of the highest interest, and have supplied materials which are invaluable to the stratigraphical geologist. In a recent paper,[1] "The Genesis of the Chalk," I endeavoured to apply a few of these results to a consideration of one of the great oceanic deposits of the past, "the Chalk," and on this basis of comparison submitted conclusions of a definite character, both as regards the depth at which it was formed and the general nature of its deposition.

In an article (*Science Progress*, February number) Mr. Philip Lake thus briefly summarises the main objections to the course adopted, and says, "In questions of this kind, when the argument is based upon the assumption that fossil forms lived and flourished under the same conditions as their recent allies, it must always be borne in mind that such an assumption is open to grave doubt. There is nothing to prevent an animal from adapting itself to live under a new set of conditions (for instance, at a different depth of the sea) without becoming so much altered as to constitute a new genus." I have, therefore, thought it would be interesting to examine the various conditions step by step, to ascertain if the above objection is of such vital importance that it must necessarily paralyse the whole argument, and neutralise the method of research pursued.

1. *Faunal Distribution.*—It will readily be admitted that any genus (whether plant or animal) may adapt itself to a change of condition without undergoing change of form. It may be even that two such forms will alter their circumstances without metamorphosis of type and character; but if a whole group of organisms retains precisely the same aspect throughout long ages, it may well be asked whether similarity of conditions during long periods should not be regarded as a determining factor in such a conservation of structure, and whether, therefore, the onus of proving objections to suggestions based on such identities should not lie with the objectors.

If we take the Upper Cretaceous strata on the one hand, and present deep-sea deposits on the other as principal terms of com-

[1] *Proc. Geol. Assoc.*, xiii., p. 221, May, 1894.

parison, it may, at first sight, appear that the existence of any uniformity in faunal character in the two cases must be absolutely impossible. The period of time which has elapsed should have been sufficient to alter and vary every specific type, and obscure any relationship which might help to guide the student. Such preconceptions, however, break down at the very outset, and though as a rule in the higher Vertebrata and Mollusca only generic resemblance can be traced and compared, yet in the lower forms of life, more especially among the Foraminifera, the identity of specific character becomes striking and significant.

The first analysis of a sample of Chalk Marl carried out by me brought the matter very prominently under my notice; for after the removal of all the clayey and calcareous material, an insoluble and heavy residue remained, which revealed itself as being largely made up of the tests of arenaceous Foraminifera.

A comparison of these with recent forms showed that most of the species still exist at the present day. This resemblance would be of little value if the same types were simply distributed far and wide in the oceanic waters; but if it can be shown that only certain localities are specially favoured, reasons should be sought to explain the occurrence.

Three *Textularia* (*T. turris*, *T. trochus*, and *T. agglutinans*) occur in the Lower Chalk Marl. Only at Culebra Island, in the West Indies, at a depth of 390 fathoms, do these same three species occur together at the present day; one of them, *T. turris*, has only been met with here and off Pernambuco, at a depth of 350 fathoms. Three species of *Verneuilina* have been determined by Mr. Chapman from the Taplow Chalk (*V. pygmæa*, *V. spinulosa*, and *V. triquetra*); these same three species have also been met with at Culebra Island, *and nowhere else do they occur together*. *Gaudryina pupoides*, *Bulimina presli*, *Haplophragmium latidorsatum*, and *Ammodiscus incertus* all occur in the Chalk Marl. They are also present at Culebra Island. I am in a position to still further multiply the cases of identity between the two, but these coincidences should be sufficient to give rise to careful thought.

Which, then, represents the line of logical hypothesis? Is it the conception that, *owing to accidental circumstances*, all these ancient specific forms have become associated unchanged in certain restricted areas? or, is it that identity of circumstances has led to their preservation, and to the similarity of distribution they display both in the Cretaceous deposits and at the above-mentioned localities at the present day?

What, then, do these circumstances appear to be? It will be noticed that Culebra Island possesses the following distinctive characteristics. It is situated close to the eastern boundary of a continental area, in a region of considerable insular development, having a sub-tropical climate, and not far removed from the line of a great current.

We are further led to inquire whether there are any other regions where similar assemblages occur, in which old Cretaceous species are still found to play an important part. The greatest interest undoubtedly attaches to Raine Island, off the north coast of Queensland, near the Torres Straits, owing to the fact that this is the only locality where, at a depth of 155 fathoms, *Tritaxia tricarinata*, so common in the Chalk Marl, is known to exist at the present day. In addition, the presence of the delicate *Spiroplecta annectens*, of *Gaudryina rugosa*, and *Frondicularia archiacana*—all Cretaceous species—shows that this is not a mere isolated occurrence, but represents another example of the preservation of Cretaceous forms under certain special conditions. An examination of the geographical position of this island likewise demonstrates that it lies not far from the south-eastern boundary of a region of insular development, which includes New Guinea, Borneo, etc. It is also on the northern boundary of the Australian continent, and, further, its climate is of a distinctly subtropical character. It is therefore significant that, although so far removed from one another, we should find these two localities to have these remarkably striking features in common, and at the same time to possess between them some of the principal arenaceous species occurring in the lower part of the Upper Cretaceous beds.

The general resemblance of these localities to probable early Upper Cretaceous conditions will at once be obvious. The materials of the Chalk Marl and Upper Greensand appear to have been derived from the western regions of our own island, so that it may be fairly argued that these deposits were laid down on the eastern boundary of a land, if not of a continental, area. Few will be inclined to dispute that the result of the Cretaceous depression would be the production of a number of insular areas, and there is much evidence to support the theory of the existence of a sub-tropical climate at that period.

Hitherto no sharp delimitation of distribution has been attempted by writers on this subject. The Foraminifera obtained from the various zones of the Upper Cretaceous have been dealt with *en bloc*, and but little attention has been paid, or reference made, to variations arising from physical alterations, bathymetric or otherwise.

The result of a preliminary study of the zones in definite order has led me to the conclusion that this wide classification tends to hide many interesting facts, and that, in order to arrive at a more complete understanding of the subject, such questions as quantity, size, specific abundance, position in the stratigraphical scale, and the character of the rocks in which the forms occur, must all be carefully noted, observed, and compared with the existing fauna and the general sequence as displayed at the present time.

For example, foraminiferal distribution depends, in many important particulars, on physical characters. The arenaceous species, more especially the coarser varieties, build up their tests of sand-

grains, for the distribution of which off-shore currents are indispensable. At the present day, the coarse arenaceous Foraminifera are found at depths rarely exceeding 400 fathoms, and the terrigenous deposits bordering true continental areas (as, for example, from the north of France to the south of Africa, or throughout the whole South American coast-line) rarely extend to a distance from the shore-line of more than 200 miles. The depression having apparently been very gradual in Cretaceous times, the coarsely arenaceous species might have occurred in shallower water than at the present day if the currents were weaker, or in deeper water if currents were stronger. For our purpose, it is only necessary to prove that the width of the border of terrigenous deposits was not less at that time than it is at present.

The deep-sea researches have shown that at points where the continental areas meet the oceanic, there is to be found a band composed of terrigenous deposits varying but little in breadth, and rarely extending more than 100 miles from the present coasts. This appears to be of almost universal occurrence, it having been traced from the north of France to the south of Africa, and it differs but little in width round Australia and South America. The evidence to hand points rather to this band having been wider in Cretaceous times, seeing that the Gault, occurring as a sandy deposit in the Blackdown Hills in Devonshire, is not represented by limestones till 170 miles from that locality, viz., in the north of Norfolk. Similarly, the Upper Greensand belt has a width of over 150 miles ere it becomes merged in the limestones of the Hunstanton district. Further, if we compare these with the width of the terrigenous belt in the Gulf of Mexico, the resemblance between the past and present conditions is very close. If, then, it be granted that the currents in those times did not greatly differ in strength from those of the present day—and, in my view, specific identity should point to similarity of condition—is there any marked parallelism in the sequence of these protozoan forms? That is to say, is there any resemblance to be observed between the upward stratigraphical sequence in foraminiferal distribution, and the variation due to bathymetric change in those species existing at the present day? My own studies lead me to the conclusion that such a resemblance not only exists, but is of a most striking character.

In the Chalk Marl and Lower Grey Chalk, the Textularian and Tritaxian fauna is very abundant; but in the upper strata of the Lower Chalk a marked change takes place, only certain species—*Textularia agglutinans* and *Haplophragmia*—of finer texture being obtained, the Bulimines now playing the most important and prominent part. In the lower zones of the Middle Chalk all the more coarsely-tested forms have entirely disappeared, and only the minutest Bulimines—a most delicate little *Textularia*, and the ammonitoid-looking shells of *Ammodiscus incertus*—survive to represent the

arenaceous species; while still higher in the scale, and running throughout the Turonian and Senonian zones (with but one exception), *Ammodiscus incertus* remains apparently the sole representative.

Turning now to the modern distribution—what is its nature and special character? The Textularian fauna is well marked up to a depth of 400 fathoms, but beyond that depth the number of species diminishes with remarkable suddenness, few being found at greater depths, though those that occur have a very wide distribution. What are the principal species which thus continue? They are *Textularia agglutinans* and *T. quadrilatera;* the former, as we have seen, a form which passes into the Grey Chalk, whereas the species, now restricted to a depth of less than 400 fathoms, are mainly found in the Chalk Marl or lower part of the Lower Chalk.[1]

The species, however, which are associated with the above *Textularia* give evidence of equal significance. Certain forms of arenaceous Foraminifera continue beyond the 500 fathoms. For example, of those obtained by me, *Haplophragmium agglutinans*, which ranged from the Cenomanian (Lower Chalk) into the Turonian (Middle Chalk), has been obtained eight times beyond that depth. On the other hand, it must be admitted that *Haplophragmium latidorsatum*, which has an equal distribution to-day, was only found by me in the lowest zone of the Lower Chalk. According to my own investigations, *Gaudryina pupoides* was similarly restricted, but from the Richmond boring Professor Judd obtained this species associated with *Textularia agglutinans*, in far higher beds of the Lower Chalk. This species has been met with at the present day eleven times at depths exceeding 500 fathoms, while *Ammodiscus incertus*, which I have found in almost every Chalk zone examined (it being absent only in the lowest zones of the Lower and Upper Chalk), occurs five times at similar depths.

The occurrence of the genus *Ammodiscus* is, in fact, a marked feature in all modern deep-sea soundings, it having been reported no less than twenty-two times from these greater depths, represented mainly by three species, *A. incertus*, *A. charoides*, and *A. gordialis*, all of which are constituents of the two upper divisions of the Chalk series, though the first at present remains the sole representative of its kind in the lower.

What, then, are the broad results to be adduced from these somewhat detailed considerations?

1. Many of the Cretaceous species of arenaceous Foraminifera are specifically identical with those of the present day.

2. Those species which are restricted to the Chalk Marl and Lower Grey Chalk are those which occur to-day at depths of less than 400 fathoms.

[1] At a depth beyond 500 fathoms one or both of these forms were obtained in "Challenger" soundings eight times, other species only three times, and these were of types unknown or exceedingly rare in the Upper Cretaceous.

3. Those that pass upwards into zones higher than those of the Lower Grey Chalk are precisely those which at the present day have a wide distribution at depths exceeding 500 fathoms.

4. The more shallow-water types of these ancient species occur together at the present time, in certain well-defined areas, notably off the West Indian Islands, and between Australia and the Papuan Islands.

5. These regions are characterised by insular development, sub-tropical climate, and are situated, in the wide sense of the term, on the eastern side of a continental area.

6. We therefore infer that the conditions were similar during Chalk Marl times, greater depression and climatic change causing alterations in physical conditions, and, consequently, variations in the characteristic fauna.

Bulimines are no exception to the sequence here laid down, for, commencing in the Chalk Marl as very coarse-tested forms, they diminish in size, until in the *Belemnitella plena* zone, at the base of the Middle Chalk, only very minute examples are as a rule met with. Their species, however, not being comparable, I have not included them in this discussion. Notwithstanding, these also have a region of maximum development ranging between 345 and 675 fathoms, and, although beyond these limits a single, or at most two, species may occur in any one sounding, the fact of the genus having been found no less than eighteen times beyond the 700-fathom limit in no way invalidates the general principle presented in no. 3 of the summary.

Certain exceptional conditions are, however, to be met with, presenting facts of great interest, and well worth consideration and study.

Thus, in the Taplow Chalk, in the centre of one of the highest zones of the Upper Cretaceous, a number of these forms reappear. This chalk is now generally accepted as a current-formed deposit, and, consequently, the Foraminifera of our Chalk Marl must have been in existence in another part of the Anglo-Parisian Basin, only requiring favourable conditions to enable them to extend their range; while current agency, as I hope to show in subsequent remarks, has had a great influence in determining local distribution.

From evidence of a lithological character, it appears probable that the above-named fauna retreated in Upper Chalk times to France, and was existing there in much shallower water, it being a noticeable fact that those species of *Textularia* which occur in our Lower Chalk (Cenomanian) are described by D'Orbigny, not from these lower beds, but from the Upper Chalk (Senonian).

In the *Proceedings* of the Geologists' Association (xiii., p. 370, Nov., 1894), Mr. Chapman has recorded the Foraminifera from the Chalk of Swanscombe. Fifteen of these species, including such ubiquitous forms as *Rotalia soldanii*, *Pulvinulina micheliniana*, *Cristellaria cultrata*, as also types of *Globigerina*, *Anomalina*, *Truncatulina*, *Bolivina*, and *Bulimina*,

are described as frequent or common associations which can be paralleled to-day from most of the deep-sea soundings, though they are not to be found grouped together at depths beyond 1,000 fathoms.

At this depth in the North Atlantic the above-named three species occur together, accompanied by all the above-named genera, except *Anomalina* and *Truncatulina;* though off the Azores these latter have been obtained at the same depth. Off Pernambuco, at a depth of 675 fathoms, every one of these genera is found grouped, two of the three species being again present.

The same holds good of the particularly rich ooze off Culebra Island, a centre where the deep-sea and shallow water forms seem to become most intimately intermingled. Below the depth of 1,000 fathoms no such associations have been discovered, and, taking into account these facts and the general aspect of the commoner fauna of this chalk, I am led to venture the opinion that it has been laid down at a depth over 400 and under 1,000 fathoms.

Again, of the rare species which have already been mentioned as very common in the Chalk Marl, a few reappear which are usually absent in the higher zones, viz., *Textularia turris, Spiroplecta annectens*, and *Tritaxia tricarinata;* but, in addition, there are a number of others specifically identical with forms now occurring at depths greater than 400 fathoms.

A consideration of these various facts seems to force upon us the conclusion that events had occurred resulting in the reappearance of a shallower fauna, but that Chalk Marl conditions had never been absolutely reëstablished. Mr. Chapman is of opinion that the Swanscombe specimens probably came from the *Micraster cor-testudinarium* zone, at whose base is the Chalk Rock. This latter shows in its character such evident traces of change in the direction of elevation that the faunal peculiarities observed may be regarded as additional proof of upward movement at this period. Thus we may conclude that during periods of elevation shallow water faunas extend their range, the extent of such range being the measure of such elevation.

Hitherto we have been dealing with a fauna which, however interesting in itself, might by many be considered as too minute in character for general study, demanding, as it does, not only painstaking research, but the direct aid of an expert in specific determination. We will, therefore, next turn to the evidence of a richer and larger fauna as represented in the Mollusca; and although parallelism by species is out of the question, yet some idea of sequence may be gathered from its study.

W. F. Hume.

(*To be continued.*)

SOME NEW BOOKS.

Crystals: Their Shape and Structure.

Crystallography: A Treatise on the Morphology of Crystals. By N. Story-Maskelyne, M.A., F.R.S. 8vo. Pp. xii., 521. 398 text figures and 8 plates. Oxford: The Clarendon Press, 1895. Price 12s. 6d.

The appearance of a treatise on crystallography from the pen of Professor Maskelyne, the *doyen* of English Crystallography, has been expected for many years. The present volume deals only with a very confined branch of the subject, *i.e.*, that which concerns the relations between the various planes bounding a crystalline individual; a succeeding volume treating of the physical properties of crystalloid matter is, however, promised. Two proofs of most of the propositions are given, a trigonometrical and an analytical one; the former are, in many cases, those contained in Miller's classic "Tract," and although very simple and elegant, are often long and possessed of all that cumbrousness which so frequently characterises trigonometrical demonstrations. The analytical proofs, many of which are new, are extremely neat, and have the great merit of brevity. It is, perhaps, to be deplored that the author should have confined his attention so closely to the Millerian methods of demonstration, as many crystallographic problems can be treated with greater ease by other methods; thus, the long arguments at pp. 58 and 70 respecting the anharmonic ratios of four tautozonal planes would surely be well replaced by the short proof recently given by Cesaro.

Not the least valuable portion of the volume is that dealing with the methods of representing a series of crystalloid planes, in which that crystallographic *pons asinorum*, the stereographic projection, is elaborately treated. The chapter relating to the types of crystalline symmetry is also one of extreme interest, owing both to the simplicity and originality of the treatment adopted. Professor Maskelyne has here exercised his peculiar faculty for the invention of new and significant terms, a faculty which is so freely employed in the later part of the book as to make it a matter of regret that a glossary has not been appended. The description of the crystalline systems is clear and concise, and the characteristics of each are logically deduced, thus eliminating that flavour of empiricism which taints most of those dry-bone hashes known as text-books of crystallography. The method employed is, however, in our opinion, not logical enough, as it is now comparatively easy to deduce the thirty-two possible crystalline systems by the rational process devised by Gadolin, or to briefly indicate how this number is arrived at by the discussion of point-systems and space lattices. This part of a crystallographic treatise would thus be relieved of such a defect as that on p. 345, where milk-sugar is described as crystallising in an impossible system. The

important, but usually much neglected, subject of crystal twinning is adequately treated, and a good description is given of the rather human property of crystalline mimicry, by virtue of which crystals so frequently pretend to higher symmetry than they really possess. Considerable space is devoted to the methods of crystal calculation, but no reference is made to the important applications which the method of least squares has received in this connection at the hands of Beckenkamp, Hecht, and others.

Many of the specific instances which abound in the volume are of specimens preserved at the British Museum (Natural History) at South Kensington. Professor Maskelyne's volume will consequently commend itself as an agreeable companion to the provincial geologist or mineralogist while holiday-making in London.

W. J. Pope.

An Introduction to Chemical Crystallography. By Andreas Fock, Ph.D. Translated and edited by William J. Pope, with a preface by N. Story-Maskelyne, M.A., F.R.S. Royal 8vo. Pp. 189. Price 5s.

Crystallography has been such a valuable aid to the study of minerals that it has almost come to be regarded as an integral portion of the science of mineralogy. That this is not the case, however, is sufficiently proved by the fact that many of the numerous products of the chemical laboratory crystallise in forms never met with in minerals. Hence, crystallography would not be complete unless these were included.

The editor of this little work (Mr. W. J. Pope), in preparing the present edition, has been actuated by the desire to make clear to English chemists the great importance of a knowledge of crystallography to their science, it having become generally recognised during the past few years that the most important advances in crystallography are to be expected from the chemical side. Despite the fact that our knowledge of the physical and geometrical properties of crystals is now very complete, their relations to chemical constitution and composition are as yet but little known, although the study of these characters by mathematicians and mineralogists has yielded results which affect some of the highest problems in chemistry. The examination of new crystalline compounds with the aid of a polarising microscope can be accomplished almost as rapidly as the determination of the melting point, and should certainly supplement the latter; inasmuch as such an examination affords an infallible test of the identity or non-identity of two substances.

It frequently happens that translators of German scientific works adhere too strictly to the idiom of the original language, and write sentences which are extremely involved and difficult to follow. This cannot be said of the work under discussion. The language used is so clear that it reads in every way as an original production. If, however, the book is compared with the German edition it is found that many modifications have been made in the text and numerous additions, so that it is brought up to the present day. These, we are told, have been done with the author's sanction. The matter is arranged in excellent sequence, and the propositions are logically argued out. The book is very free from typographical errors.

A perusal of the book can leave no doubt in the reader's mind that Mr. Pope has attained his object. The close connection of crystallography with other branches of physical chemistry is clearly

and distinctly brought out, and the book may be confidently recommended as an elementary text-book on the subject to all intending students of chemistry and mineralogy.

A. R. L.

The Evolution of Spots and Stripes.

Studies in the Evolution of Animals. By Dr. E. Bonavia. 8vo. Pp. xiii., 362, numerous process blocks. Constable & Co. Price 21s.

In this volume, which has, we fear, rather a prohibitive price, Dr. Bonavia deals with a variety of subjects, but mainly with the pigmentation of mammals. His views upon this much-debated subject are decidedly novel, but not, in our opinion, reliable as probable explanations. Nevertheless, the author has shown considerable industry in the collection of his materials, which were gathered, not only in museums and at the Zoological Gardens, but from such apparently unpromising localities as the refreshment room at the Army and Navy Stores. When an author has taken so much trouble in the amassing of fact it is churlish not to allow him a little relaxation in the way of theory. Dr. Bonavia steers a middle course between Eimer on the one hand and Darwin and Wallace on the other; but his want of success in clearing up the problems is an instance of the fallacy of the reputed safety of middle courses. Like Eimer, Dr. Bonavia holds that utility has had nothing to do with the evolution of the markings upon animals; if they are useful, it is not much more than a happy accident. He sees in spots the original plan of marking, and holds that stripes have arisen by the flowing together of spots. This is the exact converse of the opinion held by Eimer, who showed some reasons for thinking that a longitudinal striping was the primitive form, which then broke up into spots, and was recombined into transverse stripes. But both authorities are at one in looking upon the self-coloration, as is exhibited, for instance, in the Puma, as the last stage. From this point, however, Bonavia diverges in a direction peculiarly his own, which will not, we think, produce a general conviction in its favour. His view is, in short, that the spots upon carnivorous and other animals are the remains of a former armour-plating, such as is now present in the armadillos. The loss of this hypothetical armour-plating is ascribed by the author to a kind of "lime-famine" produced by too great a demand upon the supplies in the possession of Nature. It follows as an obvious corollary that the Carnivora are the nearest existing relations of the primitive mammal—a conclusion which will not, we think, meet with general acceptance. It is true that our knowledge of the earliest Mammalia is lamentably scanty; they may have possessed an extensive coating of armour-plating, but, on the other hand, the universal opinion is that the existing Monotremata come nearest in structure to the mammals of the Trias and Jura, and that the next nearest are the Marsupialia. Now, neither of these groups has any traces of a *Glyptodon*-like skin, and they are not, as a rule, well off in the matter of stripes and spots. The Edentata, which are largely plated, are admitted to be a specialised group, and in any case there is no evidence of their great antiquity. Still, Dr. Bonavia has the courage of his opinions, and argues with great ability in favour of his ingenious suggestions; and we do not find fault with any man's theories in these days of rapidly-changing views. What we can, without any reservation, congratulate Dr. Bonavia upon are his excellent figures of the skins of various cats.

F. E. B.

The Ardennes.

Walks in Belgium: Cycling, Driving, by Rail, and on Foot, with some Fishing and Boating Notes. Edited by Percy Lindley, with maps and illustrations, and a chapter on the French Ardennes. 8vo. Pp. 94. London [1895]: 30 Fleet Street. Price 6d.

We are glad to notice this attractive little guide to a country so interesting to the English student of Natural History, who, when he wishes to study continental types not to be found in his own country, cannot do better than pay a visit to the Belgian Ardennes. The book contains a great deal both of practical and picturesque information, arranged and indexed so as to be easily found when wanted. The author has a keen sense of the picturesque, and gives much information of a kind often impossible to glean from guide books, but which influences very largely a tourist's impressions of continental towns. We find it mentioned, for instance, whether a building has been much altered in appearance by restoration, and on which days markets are held, with a good deal of very readable information about the towns. There is also very useful advice for travelling and management of expenses. Perhaps it would be easier to use the advice on p. 11, where the traveller is recommended to go to good second-class hotels, if the names of these hotels were systematically given for each town. We think it a pity that two or three pages have not been devoted to saying something about the natural history of the country; but perhaps this would be too much to expect in so small a book.

Decimal Cataloguing.

The Manchester Museum Owens College. Museum Handbooks. A Catalogue of the Books and Pamphlets in the Library arranged according to Subjects and Authors. By William E. Hoyle. 8vo. Pp. xvi., 302. Manchester, 1895. Price 2s. 6d.

In this very practical catalogue Mr. Hoyle devotes 230 pages to a list of titles of books and pamphlets arranged under subjects, and in the remaining pages these papers are placed under authors in alphabetical order. One is thus enabled to find at a glance the work required, and as the press-mark is inserted at each entry both subject-catalogue and author-catalogue are complete in themselves. There is also an alphabetical index of subjects.

Marine expeditions and surveys are catalogued under the name of the ship, a practical method, and one most satisfactory to the weary searcher, who has often to shift from one end of a catalogue to the other. The chief point in the work is, however, the complete adoption of Professor Melvill Dewey's Decimal Classification, which Mr. Hoyle has also applied to the classification and registration of Museum specimens. "It is believed that the present catalogue is the first published in this country in which the method has been fully carried out." Such a lucid work as the one before us is the strongest argument in favour of the Dewey System, which in some form or other is the only possible one in large and rapidly-growing libraries where the ready finding of books is indispensable.

Starch.

Untersuchungen über die Stärkekörner. Wesen und Lebensgeschichte der Stärkekörner der höheren Pflanzen. By Dr. Arthur Meyer. 8vo. Pp. xvi., 318, with 9 plates and 99 woodcuts n the text. Jena: Fischer, 1895. Price 20 marks.

If anything were required to emphasise the extreme specialisation

which has been reached in biological science, such books as the present would amply suffice. A good deal has been done within the last ten years on starch, its chemistry, its origin, and its meaning in the nutrition-processes of plants, and although Sachs' idea that it represented the first formed carbohydrate in the cells of the assimilating green leaf is no longer tenable, it is equally certain that as an easily-worked reserve substance it is of the utmost importance in plant-physiology. Dr. Meyer's criticisms and the account of his exhaustive investigations are arranged under five headings. In the first, on the chemistry of starch and diastase, we have an historical and chemical account of the compounds of which the grain is composed, or which are formed by the action upon it of the diastatic ferment. The micro-chemical reactions are also discussed. The second part, on the physical characters, contains arguments and experimental evidence in support of the view that starch grains are sphærocrystals of amylose and amylodextrin, and concludes with an account of the structure and growth of the grains, in which Nägeli's theory of growth and intussusception is severely criticised. Part III., the biology of the starch grain, is a full account of its life-history, *à propos* of which we find a discussion of the part played by the different constituents of the chloroplast. Part IV., "Biologische Monographien," is a series of short monographs on the starch grains of the resting shoots of *Adoxa moschatellina*, the endosperm of barley, and a few other examples. Finally, we have a few pages on starch grains as constituents of living protoplasm. We must not omit a word in praise of the nine plates which, with the wood-cuts, form a very helpful addition.

Botany Books.

Das Pflanzenphysiologische Praktikum. Anleitung zu pflanzenphysiologischen Untersuchungen. By Dr. W. Detmer. Second edition, enlarged and revised. 8vo. Pp. xvi., 456, with 184 wood-cuts. Jena: Fischer, 1895. Price 9 marks.

Professor Detmer's practical exposition of plant-physiology is so well known, and has proved so valuable and trustworthy a guide on the subject, that the appearance of a second edition is not a matter of surprise. Lecturers on the subject and students of the life-processes of plants will welcome the new issue, and rejoice that Professor Detmer has been able to add so much that is new and of interest.

Analytical Key to the Natural Orders of Flowering-plants. By Franz Thonner. 8vo. Pp. vi., 151. London: Sonnenschein, 1895. Price 2s.

If we read his preface aright, Mr. Franz Thonner, who writes from Dresden, has compiled this little book for the use of English colonists, to enable them to run down to its natural order any plant in which they may chance to be interested. It is, in fact, an adjunct to the few and fragmentary colonial floras which we possess, by which, having already found the order, the student will be able to work out the genus and species. We presume this is why he uses the system of Bentham and Hooker's "Genera Plantarum,"—a truly excellent one,—but in several respects not quite on a level with our present knowledge. It seems to us that the colonist who is able to use his "Flora" will also be able to dispense with Mr. Thonner's Key, which on this view seems a waste of effort.

Some Serials.

The Archæologist (Columbus, Ohio) ceases to exist with the September number. It will in future form a department in *Popular Science News* (New York), which will be edited by Mr. W. K. Moorhead, of Ohio State University, the editor of *The Archæologist*.

We are informed that the *Mittheilungen aus dem Mineralogischen Institut zu Kiel* has also ceased to exist. Communications will in future, we believe, be published in a new periodical, *Archiv für Anthropologie und Geologie Schleswig-Holsteins und der benachbarten Gebiete*, of which the first number appeared in August, and contained a valuable paper by Dr. E. Stolley on the curious boulders of Cambrian and Silurian age which are scattered over the surface of the ground in Schleswig-Holstein.

Knowledge has published in the September number a map of the world showing the explored, partly explored, and unexplored regions. This is useful as roughly showing at a glance the great amount of work yet to be done by geographers and geologists. It has been drawn up by Professor Logan Lobley, and is appropriately published at this time of Geographical Congress.

In the same number there is an interesting illustrated paper by Mr. J. E. Quibell on the newly-found race in Egypt. The bodies are not buried at full length as was customary with the Egyptians, but in a contracted position, and usually without the head. Flint weapons, beautifully finished, have been found, as well as rude and painted pottery. Mr. Quibell thinks this previously unrecorded race were the ancient Lybians, and colour is lent to his view by the finding of a small female figure with tattoo marks in one of the graves; the Lybians themselves being of white skin and tattooed, according to the Egyptian monuments.

The Geographical Society of Finland has already issued its "Exposé des travaux géographiques exécutés en Finlande jusqu' en 1895." This communication was made to the Geographical Congress which recently met in London. It forms a volume of 154 pages, is published at Helsingfors, and adds a valuable book to the long series of geographical bibliographies.

We are glad to note the acceleration in the issue of Poirault's translation of the "Manuel de Geographie Botanique," by Oscar Drude, noticed in Natural Science, vol. vii., p. 214. Livraisons 6 and 7, just to hand, include the greater part of the fourth section of the book, which deals with the various plant formations and their characteristic families and genera. Part v., on the regions of vegetation of the globe in geographical order, is now just commenced.

Messrs. Dulau & Co. have sent us their catalogue (No. 14) of Botanical Works, comprising Systematic and Miscellaneous, Medical Botany, Botanical Biographies, and Periodical Publications.

OBITUARY.

SVEN LUDVIG LOVÉN.

BORN JANUARY 6, 1809. DIED SEPTEMBER 3, 1895.

FULL of years and of honours, rich in the reverence and love of his pupils and his friends, the greatest biologist that Sweden has known in this century has at last laid down the work that could cease only with life. Despite an attack of influenza, and again of an inflammation of the lungs some thirteen months ago, his vigorous frame struggled long with death, and sank slowly and peacefully into the final rest.

Lovén's family came from Loshult in Scania, in which fertile province his great-grandfather, Måns Jönsson, was a husbandman. It was the son of that man who first followed after learning, entering the priesthood and taking the name Lovén. His fifth and youngest son, Christian, became a wealthy merchant and shipowner in Stockholm, and to him and his wife, Maria Catharina Nordling, there was born in that city the future leader of Swedish zoology.

Thus Lovén was in a position to receive a first-rate education. Not only did he become conversant with foreign languages, of which he spoke and wrote French, German, and English fluently, but he acquired skill as a draughtsman and musician. His first school education was in the private school of the army chaplain, Fredrik Klingenstierna, and in 1823 he passed from here to the University of Upsala. In the following year, however, he moved to Lund, possibly attracted by the fame of the Professor in Zoology, Sven Nilsson. At any rate he made zoology his main study, and in 1826 accompanied the professor and four other students on a scientific expedition through Norway. At the early age of twenty he took his degree as Doctor of Philosophy.

While in Lund, Lovén nearly died of scarlatina, but recovered with the loss of hearing of his right ear. It was probably this disease that prepared the way for those many severe attacks of ill-health that persecuted Lovén in after life, and that prevented him from publishing as much as his eminent gifts led the world to expect.

After taking his degree, Lovén studied under Ehrenberg at Berlin for nearly a year; but, after the publication of his treatise on the geographical distribution of birds, he was recalled to Lund at the close of 1830 as Docent in Zoology. It was in this year, too, that he

began his researches on the marine fauna along the shores of Bohuslän, the western coast of Sweden. For eleven years Lovén remained attached to the University of Lund, carrying out these and similar researches to which we shall recur. In 1841 his reputation was such that, though only thirty-two years old, he was elected Keeper (Intendent) of the Department of Invertebrata (Insecta excepted) at the Swedish State Museum, an appointment that carries with it the title Professor to the Academy of Science, although no teaching duties are connected with it. This post he retained till September, 1892, when increasing infirmity forced him to retire with a pension. At the jubilee of his appointment, in 1891, in recognition of his long and useful labours, the Academy caused a medal to be struck bearing Lovén's portrait and the words "Sveno Loven Musei Zool. Regni Præfectus," and on the reverse the inscription "Socio meritissimo ob officia insignia per decem lustra museo zool. regni præstita Reg. Acad. Sc. Suec. MDCCCXCI."

This mention of Lovén's labours was no mere form. As a member of the Council of the Academy and as inspector of its library, as well as in his post of Intendent, he contributed actively during the greater part of his life to the development of its institutions. Encouraged by Berzelius, by whom his genius was early recognised, in 1844 he started the publication of the *Öfversigt*, and edited its earlier volumes. He drew up the plans for the enlargement of the State Museum, and during the years 1860–1864 superintended their execution. The work of building completed, he devoted several years of intense labour to the arrangement of the specimens in his department, which he made a model for other museums to copy. In their general arrangement, in the artistic display of the objects, no less than in ingenious details of technique, all invented by Lovén, these collections in the Riksmuseum still evoke the enthusiasm of museum experts. Naturally, too, Lovén laboured for the increase of these collections with abundant zeal, not merely collecting himself, but freely giving to the younger generation from his stores of learning and experience, that they might bring him in exchange treasures to enrich his beloved museum. One of these young pupils, now himself a reverend and renowned professor of the Academy, gives me his reminiscences of those days. "As a lecturer in zoology and geology, Lovén was unsurpassed in Sweden, and those who heard his lectures in 1848–49 can never forget the impressions they received. The addresses, too, which he delivered at the anniversaries of the Academy of Science were masterpieces of style. In the days of his strength there was a great charm in his conversation when he spoke of the incidents of his life or characterised the men of science he had met."

Another creation of Lovén's, of great and increasing importance to Swedish science, was the marine zoological station that he founded at Kristineberg, on the coast of Bohuslän, the same place where his

earlier researches were carried out. Although a formal station under the care of the Academy was not opened till 1877, still work had been carried on at this place almost continuously since 1835, so that Kristineberg may claim to be the oldest such station in the world. I hope to give, in an early number of NATURAL SCIENCE, a detailed account of the Swedish station, with full illustrations. For the present it need only be said that this laboratory was under the direction of Lovén until his retirement from the Museum, and that he never ceased to give it his most affectionate care.

In the wider questions of education, Lovén also took a lively interest. From 1857 to 1878 he was on the committee of the Nya Elementar Skola (Grammar School) in Stockholm, as its chairman for the last seven of those years. In this position, and also in connection with Stockholm's Högskola (University) he fought with ardour for energetic reforms, especially in the direction of what we call a modern as opposed to a classical training, and for the extension of a sound teaching of natural science. That his efforts reached yet wider circles might be inferred by those who visited the exhibition of educational appliances that was held in Stockholm last August in connection with the Congress of the School-teachers of Scandinavia.

In these and in the other public positions which he occupied, Lovén was always prominent. Another who knew him well writes:—"In the Academy his communications were always listened to with the deepest attention. His words and opinion were often decisive for its concerns. He was one of its most influential personalities."

In connection with his scientific researches Lovén travelled much, visiting amongst other countries Germany, France, and England. But the only journey to which we need here refer is that which he made through Finmark in 1836–7; for it was at the close of this, in August, 1837, that he went on a walrus-steamer to Spitzbergen, Isfjord, Crossbay, and Kingsbay, and thus inaugurated the honourable succession of Swedish arctic expeditions.

So far we have dealt with the relations of Lovén to the development of science in his native country. But he was something more than a great Swede: he was a great man of science. We may consider very shortly the leading lines of his zoological work.

His researches on the marine fauna of Bohuslän, to which reference has already been made, gave rise in 1835 to the valuable paper on *Campanularia* and *Syncoryne*, that on the entomostracan *Evadne nordmanni*, and others. His observations opened many new fields. On the one hand, they served largely as a foundation for Steenstrup's celebrated work on the alternation of generations; on the other, they led Lovén himself to the further investigation of the molluscan fauna in the Scandinavian region of the North Sea. This study occupied him from 1838 to 1860, and his papers on the geographical distribution of the northern Mollusca, on their development, on their lingual armature, and on cognate questions, show how

eager he was to elucidate the whole natural history of these animals, although the projected monograph never reached completion. Through these researches a new light was shed on the origin of the marine fauna of Scandinavia, and on the whole time intervening between the Glacial period and our own, during which northern nature was still under arctic conditions. Thus the discoveries of Lovén initiated arctic research in time as well as in space. In other words, they have given rise to a long series of papers by the naturalists of all lands on the relations of modern seas to those of the Glacial period: but in this research it must be admitted that the naturalists of Sweden still take the lead.

But this early work of Lovén has been obscured, not by the mists of time, but by the surpassing brilliance of his later work, in which he deserted the Mollusca for the Echinoderma. The two great memoirs, "Études sur les Échinoïdes" (1875) and "On Pourtalesia, a genus of Echinoidea" (1883) showed at their best both his breadth of view and his unwearied patience. In the whole range of Echinoid literature there is nothing that can compare with these two masterly works. The monograph on *Pourtalesia* gives the result of a searching investigation into the varying structure of the test in the species of this genus. The "Études" is an analysis of the composition of the test in a series of representative genera of sea-urchins. Before this time there had been no means of determining the orientation of the test in the Regular Echinoidea; Lovén discovered a number of almost microscopic characters in the ambulacral plates around the mouth, and these enabled him to determine the anterior segment of the animal. The position of the madreporite (the sieve-like plate by which the water-vessels communicate with the exterior) in the apical system of plates, the distribution of the bands of slender spines known as fascioles, and the slight deviations from bilateral symmetry in the arrangement of the plates, were all made by Lovén's patient researches to yield most valuable aid in the classification of the sea-urchins. His work, however, did more than this. His theory as to the nature of the two zones of plates around the anus of the Regular Echinoidea, and the homologies that he maintained between those plates and certain plates in the other groups of Echinoderma, notably the calycal system of the Crinoidea, may or may not meet with final acceptance. But his views proved a most beneficial stimulus to biological thought, and not least to the labours of our own countrymen, while their services to echinoderm morphology have been incalculable. Here, also, he was the first to draw attention to the minute structures to which he gave the name "sphæridia" and attributed a sensory function. In his later remarkable work "On the Species of Echinoidea described by Linnæus" (1887) Lovén continued his studies on the test of the sea-urchins, especially with reference to that minuter system of ornament which he named "epistroma," and which he believed to be a modification of the

membranous envelope of the larva. His last work, "Echinologica," published in July, 1892, was chiefly devoted to the teeth of the sea-urchins and their accessory structures. In the posthumous work of Angelin, the "Iconographia Crinoideorum," the Cystidea were edited by Lovén, but his great work on these obscure ancestors of the echinoderms was never written. The beautiful plates are prepared and lie in the Riksmuseum, but the brain that should inform them with a connected meaning and elucidate them by the garnered knowledge of eighty-six years has left the toil to other and lesser heads.

The published works of Lovén, and, indeed, the non-publication of the others, all bear witness to his extreme caution. He worked slowly and with the greatest care; himself the most severe critic of his own work, he left but little for others to criticise. It is partly this caution, partly the extent of his knowledge, and partly, perhaps, some prophetic imagination, that lend to many passages of his writings their deep suggestiveness, unfathomable except by those that have themselves long studied the questions with which he deals.

The honours that came to Lovén from learned bodies or from Governments, and the societies—including agricultural, literary, and musical—of which he was elected an ordinary or honorary member, cannot here be recounted in full. So early as 1872 he was elected a Corresponding Member of the French Institute in preference to no less than Charles Darwin, while two years ago he received the Prussian order, "pour la mérite," this time in competition with Huxley. "I have had remarkably bad luck," said he, "to be preferred to the very two naturalists whom I myself rated most highly. But it is not my fault." Lovén was also a Foreign Member of the Royal Society of London, and of the Academies of Science at Berlin and Vienna.

Portraits of Lovén have been published. A bust and an oil painting may be seen in the rooms of the Swedish Academy. But all fail to do him justice. Of great stature and of noble feature, he impressed one the rather with the sympathy of his manner and the sweetness of his expresssion. These floating and indefinable shades have been fixed by no artist, but will ever live in the hearts of those that knew him.

I cannot better finish this tribute to a great and a lovable man than by quoting the words with which Professor Gustaf Retzius ended his eloquent and feeling article in the Stockholm newspaper, *Aftonbladet*, on the day of Lovén's death—words with which (may I take it upon myself to say?) all English naturalists will deeply sympathise:—

"Sven Lovén belonged to a family distinguished by personalities prominent both in science and in affairs. Round his open grave, which already holds two of his most beloved children—his daughter Agnes and his son Sigurd, the eminent physician—this numerous family

now stands in mourning, and amongst them the nearmost is his aged wife, who with never-tiring love shared with him good and evil, joy and sorrow, and who was his firm support through the trial-times of age as she had been through those of manhood.

"But outside there is seen a wider circle of all the toilers and all the friends of Swedish science, who in this old man that has gone forth had learnt to honour, not merely their Nestor, but one who was great in the land of science, one who by his discoveries and researches had mightily brought knowledge on its way, to the honour of his country, to the profit of mankind.

"And without doubt our tokens of mourning and of homage are shared by many friends of research in other lands. For the name of Sven Lovén belongs to those that have gone out over the world, and his memory will live as long as Science tells her story to the generations that are to come."

F. A. Bather.

HENRI ERNEST BAILLON.

Born 1827. Died 1895.

LIKE other botanists of repute of the generation now rapidly leaving us, Baillon began his professional life as a medical man, his career as a student having been exceptionally brilliant. In 1863, however, he was appointed Professor of Botany at the École de Médecine, and occupied the chair until his sad and sudden death last July. He was also president of the Paris Linnean Society, which he helped to found in 1866. He was a foreign member of our Royal and Linnean Societies, but, owing to an unfortunate quarrel with those in power in his own country, did not there meet with those marks of recognition which, as one of the first botanists of his day, he had fully earned.

Baillon was a voluminous author. Works like the "Histoire des Plantes" and the "Dictionnaire de Botanique" will be a lasting testimonial to his wonderful energy and power of sustained effort. The former, begun in 1867, was only interrupted by his death, when it had reached vol. xiii., and was nearly finished. It forms one of the best accounts of the families and genera of the plant world, and the many well-executed illustrations are not the least valuable part. The "Dictionary of Botany," occupying four quarto volumes, appeared between 1876 and 1892; many of the articles were contributed by the editor. For nearly twenty years (1860–79) he produced (it was nearly all written by himself) the periodical known as *Adansonia*. The volumes, of which there are twelve, came out at irregular intervals, and represent a large amount of original work in morphology and systematic botany. He started the *Bulletin Mensuel* of the Linnean Society of Paris in 1874, and continued to prepare it during the rest of his life. Here, again, a great number of the original communications are from his own pen; it is especially rich in his

descriptive work of the Madagascar flora. He was also responsible for the botanical section of Grandidier's "Histoire de Madagascar," the "Histoire naturelle des Plantes," of which, however, only volumes of plates have hitherto appeared.

In 1884 he provided his students with a text-book, "Traité de Botanique Medicale, Phanerogamique," a thick volume of 1,499 pages, followed, in 1889, by a volume on the Cryptogams.

Nor did he neglect local botany. "Les Herborisations Parisiennes" (1890) is an excellent little guide for those interested in plant-collecting near Paris; while in the "Iconographie de la Flore Française" (1885–94) the flora of the whole country is illustrated by 500 cards, bearing on one side a coloured drawing of a species, and on the other a botanical description and mention of its properties and habitat.

Besides the above, which represents almost a life work, Baillon was the author of more than 200 papers dealing with systematic botany and plant morphology. It is matter for deep regret that so busy and useful a life should not have run a longer course.

JAMES CARTER.

BORN 1814. DIED SEPTEMBER, 1895.

WE regret to announce the death of this well-known student of the decapod Crustacea. Mr. Carter was educated for the medical profession, studying at Guy's, and settled in Cambridge about 1840, where his leisure was spent upon questions of antiquarian and geological interest. His work mainly dealt with the fossil Crustacea, and we learn from the *Athenæum* that the results of his labours upon this group are in a sufficiently complete state for publication. He was M.R.C.S. 1836, F.R.C.S. 1876, and a Fellow of the Geological Society. His collection of local fossils has been for some years in the Woodwardian Museum.

Mr. Carter was a familiar figure in geological circles; his cheery and active presence did not in the least suggest his age, and he will be greatly missed by a large circle of friends.

WE learn from *Naturæ Novitates* that the Spanish entomologist, Dr. L. PEREZ ARCAS, died on September 24, 1894, in Requena, at the age of 70 years. He was not a prolific writer, and one of his last papers dealt with questions of nomenclature.

M. JULES VESQUE, of the Faculté des Sciences, Paris, who died on July 25, in his 47th year, was known as the author of the monograph on the Guttiferæ in De Candolle's "Monographiæ Phanerogamarum." Vesque was a strong supporter of epharmosis, or the use of anatomical characters in systematic botany. He also worked at plant-physiology, and was the author of a "Traité de Botanique."

The death of Marshall McDonald, which occurred on September 1 at Washington, robs the United States Fish Commission of an able and valued officer. When Professor Spencer Baird died, the post was temporarily occupied by Professor Brown Goode, and subsequently accepted by Mr. McDonald, who was chief assistant commissioner. The appointment was a successful one, and the department over which Mr. McDonald presided has become one of the most important economic bureaus of the Government. Mr. McDonald was the inventor of a stairway to enable salmon to ascend rapids, and his services have been of considerable value to the progress of pisciculture in the United States and elsewhere. The office of Fish Commissioner is now a most important one, and it is hoped that one of Mr. McDonald's assistants will be chosen to succeed so capable an administrator.

Among others who have recently passed away, we notice Dr. R. Krause, the anthropologist, at one time of the Museum Godeffroy in Hamburg, who died at Schwerin (Mecklenburg) on July 25; Dr. Felix Hoppe-Seyler, Professor of Physiological Chemistry at Strassburg, who died on August 11 at Wasserburg on the Bodensee, aged 70 years; and Dr. Thomas Henderson Chandler, dean of the Harvard Dental School, who died on August 27, at the age of 71.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

THE following appointments have recently been made: Mr. A. Vaughan Jennings, Demonstrator in Geology and Botany in the Royal College of Science, Dublin; Dr. Herbert Hurst, Demonstrator in Zoology at the same institution; Dr. Siefert, as Professor of Forestry at the Technische Hochschule of Karlsruhe; Joseph Bissett, of Aspatria, as Agricultural Lecturer to the County of Ayr; Professor Kallies, of Göttingen, to the chair of Anatomy in the University of Tübingen; Dr. Emil Yung, as Professor of Comparative Anatomy and Zoology at Geneva University, in succession to Carl Vogt. Mr. G. E. Grimes and E. Vredenburg, of the Royal College of Science, have entered the Geological Survey of India; and Dr. M. Miyoshi has been appointed Professor of Botany at Tokio University. Dr. Julius Pohl becomes Professor of Pharmacology at Prague University; Dr. R. Metzner, Professor of Physiology at Basle; Dr. J. V. Rohon, Professor-Extraordinarius in Histology at Prague, and Dr. W. Roux, Professor of Anatomy at Halle.

Professor H. F. Osborn has resigned the Deanship of Columbia College owing to pressure of work—he still retains his Professorship; Dr. T. P. Lotsy is leaving the botanical school of the Johns Hopkins University to become assistant under Dr. Treub at the Buitenzorg Botanic Garden.

PARAGRAPHS have appeared in the newspapers recently respecting the changes in progress among the staff of the British Museum (Natural History). Beyond the fact of the retirement of Dr. Albert Günther (by age limit) in October, nothing has been officially announced, and the various notices which have appeared are purely speculative.

PROFESSOR ALBERT KÖLLIKER has been elected a correspondent of the R. Accademia dei Lincei; Professors K. W. von Gümbel, K. A. von Zittel, A. Cossa, and Alexander Agassiz have been elected corresponding members of the Berlin Academy. Baron F. von Mueller and Professor Ferdinand Cohn have been elected to the corresponding memberships of the Paris Academy, vacated by the deaths of Professor Pringsheim and Count Saporta.

WE are glad to hear that a civil list pension of £200 has been granted to the widow of the late Professor Huxley, whose almost quixotic honesty and generosity in money-matters were well-known. The scheme for the Huxley memorial has grown, and assumed an international form.

A COMMITTEE has been appointed for the purpose of commemorating the memory of the late Dr. Valentine Ball. It is proposed to place a marble bust of Dr. Ball in the National Museum, Dublin, and, if the funds admit, to have a portrait painted and placed in some suitable position. Dr. Samuel Gordon, Hume Street, Dublin, is the treasurer. A similar committee has been formed in Halifax to commemorate the educational and scientific work of the late Mr. James W. Davis. The memorial is to take the form of a bust and tablet, to be placed in the new Technical School.

Dr. John Murray has signalised the close of the work of the "Challenger" Expedition in a most pleasing way. He has presented a medal to the naval officers, the contributors of memoirs, and the civilian staff of the Expedition. The medal is of bronze, is three inches in diameter, has been designed by Mr. W. S. Black, and modelled by Mr. Birnie Rhind. On the obverse is seen the head of Athena, with an owl resting on a globe which is surrounded by water, from which Neptune rises holding a trident and a trawl. On the right is a dolphin, while below are two mermaids supporting a riband bearing a legend, "Voyage of H.M.S. 'Challenger,' 1872–76." On the reverse is the badge of the vessel, a mailed warrior who has cast his gauntlet to Neptune, whose trident rises behind the challenger. A riband runs round the margin, returns along the base, enfolds the trident, and bears the words "Report on the Scientific Results of the 'Challenger' Expedition, 1886–1895." The name of the recipient has been engraved around the edge. The medal is of considerable artistic beauty, and recognises in a most fitting way the valuable and exhaustive labours of those who have contributed to the success of the Expedition.

Edinburgh Summer Meeting.—During the ninth session of the Edinburgh Summer Meeting, which was opened by Lord Reay on August 5, and continued throughout the month, the scientific side was represented by Professor Lloyd Morgan (on Evolution Ethics), Professor Haddon (on the Savage Mind), Dr. Irvine (on the Nervous System), Mr. J. Arthur Thomson (on the Biology of the Seasons), Mr. Robert Turnbull (on Applied Botany), Dr. W. W. J. Nicol (on Everyday Chemistry), Elisée Reclus, Professor Geddes, and Mr. Herbertson (on the Evolution of Cities), Mr. J. G. Goodchild (on the Geology of Edinburgh), and so on. The success of this meeting seems to continue to justify its existence—in holiday time.

That the go-ahead policy of our American cousins is sometimes marred by exceptions will be evident from the following quotation. "On account of serious financial difficulties and a distrust of the progressive and enlightened educational policy of President John, the trustees of De Pauw University, at Greencastle, Indiana, have forced the resignation of the President, and set about a return to the old paths. The department of biology, having been founded by Dr. John, was among the first to suffer. It was summarily abolished, the announcement being made, without previous warning, only the day before commencement. From a professor of zoology and one of botany at the beginning of the last college year, the instructional force is reduced to a single tutor, who is expected to give instruction in the elements of both sciences."

We learn from the *Botanical Gazette* (August) that the McGill University is the recipient of a generous gift from Mr. W. C. McDonald, of Montreal, in the form of thirty-five acres of ground for the use of the botanic garden.

Also that Professor Mottier's duties in Indiana University will be undertaken by Dr. G. J. Peirce while the former is absent abroad.

The report of the Curator of the Archæological Museum of the Ohio State University, published in the September number of *The Archæologist*, shows a good record of work done on and among the remarkable mounds of the Ohio State. This department of the University has been in existence but a year and a half, and Mr. Warren K. Moorhead must be congratulated on his success. No less than 25,000 specimens have been accumulated, the bulk of which came from Fort Ancient, while large series are shown from the Scioto Valley and other places of importance in the State. Mr. Moorhead hopes that funds will soon be available for publication of an illustrated and detailed report.

The Mayor of San Francisco, Mr. Adolph Sutro, has offered to the Regents of the University of California thirteen acres of land on which to erect buildings for

the affiliated colleges of the University. In addition to this, *Science* says, he offers to transfer to the city another thirteen acres as a site for the Sutro Library. This contains 200,000 volumes.

THE Board of Governors of the Canterbury Museum, Christchurch, New Zealand, have issued a guide to the collections, compiled by Captain F. W. Hutton. This has been written "more for the ordinary visitor who would like to know something about the things he is looking at, but whose knowledge is in another direction. The main object, however, of the guide is to make the museum a real educational establishment, and in writing it the wants of teachers have been kept in view." Captain Hutton has succeeded in doing this admirably.

ATTENTION must be drawn to the remarkably successful case of Bustards recently placed in the British Gallery of the British Museum (Natural History). Among the whole series of taxidermic triumphs at that institution we cannot recall anything better, while as an illustration of the male displaying before the female, it is perfect.

THE statue of Richard Owen to be placed in the hall of the British Museum (Natural History) has during the past month been on view in plaster at the museum. It is a striking likeness and has a satisfactory pose, the hands being especially lifelike. Owen holds a bone of *Dinornis*, on which he appears to be demonstrating to an audience.

As we announced in September last year, the Swiney Lectures to be delivered this year by Dr. J. G. Garson, will deal with "The Geological History of Man." As no arrangements have as yet been made for the lecture theatre at the Natural History Museum, Dr. Garson will speak in the lecture theatre of the South Kensington Museum. The lectures will commence on Friday, October 4, and will be continued on Mondays, Wednesdays, and Fridays during the month. They will be delivered at five o'clock, a considerable improvement for public convenience, and will be illustrated by the limelight lantern, thus marking progress in this department.

THE Natural History Department of the Science and Art Museum at Dublin has received the collection of British insects formed by the Rev. W. F. Johnson of Armagh. Many of his specimens of Coleoptera are record finds for the British Islands, and this gives the collection a peculiar interest.

MR. ADRIEN DOLLFUS announces, in *La Feuille des Jeunes Naturalistes*, that he has succeeded in obtaining promises of voluntary assistance in the naming of specimens for school museums in France. This is a great stimulus to boy-collectors, who are often hindered from pursuing their subject by the difficulty of obtaining advice and help.

THE Report of the Geological Photographs Committee of the British Association shows good progress. One thousand and fifty-five photographs were received and registered up to the month of August, 1894, and 123 have been received during the last twelve months. The collection will shortly be deposited in the Museum of Practical Geology. The Committee issue a circular of recommendations as to suitable apparatus, size of photograph, etc. It is greatly to be desired that the Committee should induce some person in England to devote his attention to the publication of a series of geological photographs, and so render them accessible to the public, as is done by Mr. Welch, of Belfast, whose collection of photographs of geological features in Ireland is remarkable alike for beauty of execution, uniformity of size, and scientific interest.

The attendance at the Ipswich meeting of the British Association was 1,324, and the subscriptions amounted to £1,236. The amount allotted to the grants is £1,160. Among the new grants, the following will interest our readers:—Reprinting Discussion on the Relation of Agriculture to Science, £5; Palæolithic Deposits at Hoxne, £25; Fauna of Singapore Caves, £40; Age and Relation of Rocks near Moreseat, Aberdeen, £10; African Lake Fauna, £100; Oysters under normal and abnormal environment, £40.

The International Congress of Zoologists has appointed an international committee of seven members (Professor S. J. Hickson being the English representative) to ensure the permanence and proper working of the Central Bibliographic Bureau for Zoology. The Congress has unanimously accepted the scheme; but in the Zoological Section of the British Association there was a lively debate on the subject, and the section has appointed a committee to report to it on the value of the proposals.

The *Proceedings of the Croydon Microscopical Club*, 1894–95, have just reached us. The strength of the club is 242, a slight diminution of numbers, which we hope will be made up during the next year. There is also a small deficit in the balance sheet. There is a pleasing reference to the former energetic secretary, Mr. W. Low Sarjeant, who has gone to New Zealand for his health, and who hopes to employ his leisure in photographing details of natural history life. The president, Dr. Frankland Parsons, made a strong case for the establishment of a local museum in the new municipal buildings. The chief paper in the *Proceedings* is the second part of Mr. Whitaker's report on Surrey well-sections.

The Borough of Nottingham Central Free Public Lending Library has issued a "Class-List of Science; with an Index of Subjects and Authors." This is divided into general science, astronomy, biology, botany, chemistry, ethnology, geology, mathematics, metallurgy, microscopy, physics, physiology, and zoology. These subject catalogues should prove of great service to readers. There are twenty of them, and the price ranges from one penny to threepence.

The last number of the *Schriften des Naturwissenschaftlichen Vereins für Schleswig-Holstein* (vol. x., part 2) contains an interesting paper by R. von Fischer-Benzon on Hildegard's "Physica." Hildegard was a Benedictine, was born at Bechelheim about 1098, and died in 1179 at St. Ruprechtsberg, near Bingen. "Physica" was the first work on the Natural History of Germany.

Dr. H. J. Johnston Lavis has a long and interesting paper on the Geology, Agriculture, and Economics of Iceland in the September number of the *Scottish Geographical Magazine*. This is the result of a journey made in company with Dr. Tempest Anderson, of York, in the summer of 1890. The paper is well illustrated by photographs taken by the author.

Professor John Milne announces in *Nature* that he has established a small station at Shide Hill House, Shide, Newport, Isle of Wight, for the recording of earthquakes having an origin in distant localities. Communications for the *Transactions of the Seismological Society* and the *Seismological Journal* should be addressed to him there.

Dr. E. Selenka has not yet returned to Erlangen from his natural history expedition. Letters have been received stating that Dr. Forsyth Major and his companion were alive and well in July last. News has been received of the Jackson-Harmsworth Arctic Expedition; the "Windward" is at Vardö, the expedition started northwards from Franz Josef Land in July. A Reuter's telegram from Norway of September 17 states that the "Fram" has twice been sighted by Esquimaux in lat. 65° N., off the E. coast of Greenland, embedded in drift ice.

CORRESPONDENCE.

Miocene Man in Burma.

Many of us on reading Dr. Noetling's exceedingly modest paper on "Chipped (?) Flints in the Upper Miocene of Burma" (*Records Geol. Survey of India*, vol. xxvii., p. 101), felt that his case was probably rather understated than overstated. Nor did Dr. Blanford's warning (*Nature*, vol. li., p. 608) in any way alter the importance of the discovery. Mr. R. D. Oldham (Natural Science, vol. vii., p. 201) now gives us a new reading of the observations made in the field; but we have a right at once to ask for an expansion of his statement that implements (presumably similar) are "scattered over the surface of the plateau above." Geologists will be glad to be informed that these implements have been compared, as to form, material, and state of preservation, with those from the weathered surface of the conglomerate; and it is of obvious importance that some portion of the conglomerate itself should be quarried out on the chance of finding chipped flakes within it. Dr. Noetling's case may, of course, prove to be entirely unsupported. All I would now urge is that no authority should write of such a question "that the degree of proof required varies inversely with the inherent probability of the proposition to be proved." Surely the existence in the Pliocene period of a man-like animal capable of making implements is to many of us one of the highest probabilities. Geologists, above all, should be especially careful lest the recording of traces of man in Pliocene or older periods be rendered dangerous to the reputation of the observer, and a check be thus given to discussion and research. The treatment of the magnificent series of skulls of the Neanderthal type as mere sports of nature, of no especial import, has shown how little even professed evolutionists care to admit the mental development of man. The close of the Pliocene period has nothing mystic or magical about it, nor is it likely that man sprang full-armed from glacial furrows. Let us ask ourselves candidly on which side of the question does probability lie.

Grenville A. J. Cole.

Royal College of Science for Ireland, Dublin,
August 27, 1895.

Phosphate Nodules of the Red Crag.

Mr. Reid, in his paper on the Geology of Ipswich and its Neighbourhood, alludes to the "Coprolites" (Natural Science, vol. vii., p. 174). It may interest your readers to know that an account of their discovery will be found in the *Technologist*, vol. iv., p. 111, and in *The Mediterranean Naturalist*, vol. ii., p. 235. It was in 1842–3, when the late Professor J. S. Henslow and myself were collecting fossils from the Crag, that my father, who was a first-rate geologist, and, of course, well acquainted with Buckland's Liassic "Coprolites," at first thought the dark brown rolled nodules of the Crag might be of the same nature, and this was the origin of the mistake in the name. He sent some to Mr. Potter of Lambeth to be analysed, who reported that they contained upwards of 50 per cent. of phosphate of lime. Hearing this, he at once communicated the fact to Mr. (now Sir) J. B. Lawes, who asked for a ton to be sent him. This was soon collected from the fallen cliff and beach. From that moment they became of great commercial value. In 1848 the Professor suggested to Mr. Deck, chemist, of Cambridge, to analyse the nodules from the Greensand of that neighbourhood. These proved to contain from 50 to 60 per cent. This, also, was the origin of the subsequent extensive workings in Cambridgeshire.

In Suffolk the phosphate nodule bed of the Crag was apparently deposited *before*

the Bryozoan (Coralline) Crag, as it was detected *below* the "White Crag" in a pit dug at Ramsholt, but long ago filled up. As this earlier Crag is more locally deposited, the phosphate bed is usually between the Red Crag and the London Clay. It has yielded remains of many land animals of the Miocene or Oligocene periods, which would not be represented in our museums had it not been for the discovery of the commercial value of the nodules. The late Mr. Charlesworth was good enough to let me see all that passed through his hands, so that at one time I was able to make a tolerably complete set of water-colour drawings of the mammalian fossils of this bed, including *Hipparion*, *Rhinocercs*, *Mastodon*, and *Cervus*. They have never been published.

George Henslow.

A Plague for Locusts.

To supplement the note on this subject (*ante*, p. 152) by Miss Smith on the fungoid destruction of locusts in Natal, I may state that I observed a similar mortality among Orthoptera at the same time in this neighbourhood of the Transvaal, showing that the "locust epidemic" must have covered a wide area between here and the coast.

On this occasion the insects attacked were smaller species of Acridiidæ, belonging to more than one genus, and were only found on the leaves of *Acacia mollissima*, an Australian wattle, the bark of which, as grown in Natal, produces a higher percentage of the tannin principle than it does in its original habitat. These Orthoptera had died clinging tenaciously to the leaves, and were with difficulty detached after death, as was the case with the Durban locusts.

I may add that our last locust swarms here were composed of a different species to the *Pachytylus migratoroides*, Reiche, the ordinary South African scourge, and the one solely constituting the vast hosts observed here previously by myself in 1891. This year we were visited by a larger species with a redder coloration, which I hope to identify on my return to England.

Pretoria, W. L. Distant.
August, 1895.

ERRATA.

We regret that, because the corrected proof went astray in the post, several mistakes appeared in Mr. Carpenter's article "Some Recent Insect Literature" in our last number. The principal corrections to be made are:—

P. 180, for *Gibelbula* read *Libellula*.
" " Planipeunia read Planipennia.
" " Tricoptera " Trichoptera.
" 182, " sunflies " sawflies.
" 183, " pupillæ " papillæ.
" " de Saumere " de Saussure.

NOTICE.

To Contributors.—*All communications to be addressed to the* Editor *of* Natural Science, *at* 22, St. Andrew Street, Holborn Circus, London, E.C. *Correspondence and notes intended for any particular month should be sent in not later than the* 10*th of the preceding month.*

To the Trade.—Natural Science *is published on the* 25*th of each month; all advertisements should be in the Publishers' hands not later than the* 20*th.*

The "Challenger" Number.—*In reply to enquiries, we remind our readers that, although the* First *edition of this ran out of print immediately, there are still some copies of the* Second *edition to be obtained at the usual price—*One Shilling. *No more will now be printed, so orders should be sent at once.*